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SIMULATION OF TRIPLE-SPOOL TURBOFAN ENGINE

Edward K. Norvaisis

Air Force Aero Propulsion Laboratory Wright-Patterson Air Force Base, Ohio

April 1974

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Chief, Turbina Engine Division

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of the major engine components. Information on setting up the Block Data and input data is given in the report. Also included is a complete program listing with a description of each subrouting and sample

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# FOREWORD

This report was prepared in the Performance Branch (AFAPL/TBA),

Turbine Engine Division, Air Force Aero Propulsion Laboratory, WrightPutterson Air Force Base, Ohio, under Project 668A0215, with Edward K.

Nievaisis as Project Engineer.

This report covers work conducted within the Performance Branch in the time period between April 1973 and January 1974.

## **ABSTRACT**

TRISPL is a computer program that simulates steady-state design and off-design performance of triple-spool turbofan engines. The program has been formulated for an engine type with two core spools and one fan spool but can easily be modified for other engine types (two fan spools and one core spool, for example). The program, written in Fortran IV language, uses performance maps (in Block Data format) of the major engine components. Information on setting up the Block Data and input data is given in the report. Also included is a complete program listing with a description of each subroutine and sample results.

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# SYMBOLS

# STATION NUMBERS 1 ambient 2 fan entrance fan exit/intermediace compressor and duct entrance 21 intermediate compressor exit/high compressor entrance 22 high compressor exit/burner entrance 3 burner exit/hi pressure turbine entrance hi press. turbine exit/int. press. turbine entrance 45 5 int. turbine exit/low press. turbine entrance low press. turbine exit 55 afterburner entrance afterburner exit main nozzle throat 8 main nozzle exit duct burner entrance 23 duct burner exit 24 duct exit if mixed flow engine 25 duct nozzle throat 28 29 duct nozzle exit THERMODYNAMIC PROPERTIES total temperature (degrees R) T total pressure (atm)

total enthalpy (Btu/lbm)

total entopy (Btu/1bm °R)

S

TS static temperature (degrees R)

PS static pressure (atm)

FAR fuel-air ratio

AM Mach number

V velocity (ft/sec)

COMPONENT SYMBOLS

F fan

I intermediate (middle) compressor

c high pressure compressor

B, COM combustor

D, DUC fan duct

THP high pressure turbine

TIP intermediate turbine

TLP low pressure turbine

A, AFT afterburner

NOZ nozzle

M main nozzle

OB overboard

T total

ENGINE SYMBOLS

ETAR ram recovery, P2/P1

CN ratio of corrected speed to design corrected speed

PCN percent of design shaft speed

PR pressure ratio

In addition to all input symbols, the following are output:

A	areas (ft <sup>2</sup> )
AM	Mach numbers
BLDU	total bleed flow into duct (lbm/sec)
BLDUC	<pre>bleed flow into duct from high-pressure compressor (lbm/sec)</pre>
BLDUI	bleed flow into duct from intermediate compressor (1bm/sec)
BLC	high-pressure compressor bleed flow (lbm/sec)
BLF	fan bleed flow, overboard (1bm/sec)
BLHP	total bleed flow to high-pressure turbine (lbm/sec)
BLHPC	high-pressure turbine cooling bleed from high-pressure compressor (lbm/sec)
BLHPI	high-pressure turbine cooling bleed from intermediate compressor (lbm/sec)
BI.I	intermediate compressor bleed blow (lbm/sec)
BLIP	total bleed flow to intermediate turbine (lbm/sec)
BLIPC	intermediate turbine cooling bleed from high- pressure compressor (lbm/sec)
BLIPI	intermediate turbine cooling bleed from intermediate compressor (lbm/sec)
BLLP	total bleed flow to low-pressure turbine (lbm/sec)
BLLPC	low-pressure turbine cocling bleed from high- pressure compressor (lbm/sec)
BLLPI	low-pressure turbine cooling bleed from intermediate compressor (lbm/sec)
BLOB	total overboard bleed flow (1bm/sec)
BLOBC	overboard bleed flow from high-pressure compressor (1bm/sec)
BLOBI	overboard bleed flow from intermediate compressor (lbm/sec)

pressure thrust (1bf) FGP

net thrust (1bf) FN

ram drag (1bf) FRD

initial or guessed values GU

number of loops thru engine before quitting ITRYS

LOOPER number of loops thru engine

SFC specific fuel consumption (lbm/lbf/hr)

TOLALL tolerance on convergence

flight speed (ft/sec) V۸

٧J jet velocity (ft/sec)

INPUT SYMBOLS

altitude (ft) ALTP

flight Mach number AM

Mach number at low pressure turbine exit AM55

afterburner entrance Mach number at design AM6

**8**A main nozzle throat area - can be changed at off design -

 $(ft^2)$ 

A28 duct nozzle throat area - can be changed at off design -

(ft<sup>2</sup>)

CNHPDS design corrected speed - high pressure turbine

CMIPDS design corrected speed - intermediate turbine

CNLPDS design corrected speed - low pressure turbine

**CVDNOZ** duct nozzle velocity coefficient

CVMNOZ main nozzle velocity coefficient

DELFG, DELFN, delta degradation multiplier for gross thrust, net **DELSEC** 

thrust, and specific fuel consumption, respectively.

Usually input as 1.0

**DPAFDS** afterburner design pressure drop, AP/P

DPCODS combustor design pressure drop,  $\Delta P/P$  DTCODS combustor design temperature rise, \(\text{\sigma}\)T (°R)

ETAA afterburner efficiency

ETABDS combustor efficiency at design

ETACDS high-pressure compressor adiabatic efficiency at

design

ETAD duct burner efficiency

ETAFDS fan adiabatic efficiency at design

ETAIDS intermediate compressor adiabatic efficiency at design

ETAR ram recovery, P2/P1

ETHPDS high-pressure turbine adiabatic efficiency at design

ETIPDS intermediate turbine adiabatic efficiency at design

ETLPDS low-pressure turbine adiabatic efficiency at design

HPEXT horsepower extraction

LAFTBN index on afterburning desired

IAMTP index on ram or inlet operation desired

IDBURN index on duct burning desired

IDCD duct nozzle will be convergent-divergent when IDCD=1

IDES index for design point; must be set equal to 1 to

design engine; zeroed automatically

IDUMP index for dumping error matrix

IGASMX index for mixed flow or non-mixed flow turbofans

IMCD main nozzle will be convergent-divergent when IMCD=1

ITRYS index for maximum number of iterations

MODE independent variable designator for engine operation

NOZFLT index for floating main or duct nozzle

PCBLC % of total high-pressure compressor airflow that is bled

PCBLDUC % of high-pressure compressor bleed flow that is bled

into duct

PCBLDUI	% of intermediate compressor bleed flow that is bled into duct
PCBLF	% of total fan airflow that is bled (overboard)
PCBLHPC	% of high-pressure compressor bleed flow that is bled to the high-pressure turbine
PCBLHPI	% of intermediate compressor bleed flow that is bled to the high pressure turbine
PCBLI	% of total intermediate compressor airflow that is bled
PCBLIPC	% of high-pressure compressor bleed flow that is bled to the intermediate turbine
PCBLIPI	% of intermediate compressor bleed flow that is bled to the intermediate turbine
PCBLLPC	% of high-pressure compressor bleed flow that is bled to the low-pressure turbine
PCBLLPI	% of intermediate compressor bleed flow that is bled to the low-pressure turbine
PCBLOBC	% of high pressure compressor bleed flow that is bled overboard
PCBLOBI	% of intermediate compressor bleed flow that is bled overboard
PCNC	high-pressure compressor shaft speed as a percent
PCNCDS	design high-pressure compressor shaft speed as a percent
PCNF	fan shaft speed as a percent
PCNFDS	design fan shaft speed as a percent
PCNI	intermediate compressor shaft speed as a percent
PCNIDS	design intermediate compressor shaft speed as a percent
PRCDS	high-pressure compressor pressure ratio at design
PRFDS	fan pressure ratio at design
PRIDS	intermediate compressor pressure ratio at design
P <b>\$</b> 55	static pressure at low-pressure turbine exit (atm)
P2	fan face total pressure, for nonstandard days (atm)

TFHPDS	high-pressure turbine flow function at design
TFIPDS	intermediate turbine flow function at design
TFLPDS	?nw-pressure turbine flow function at design
TOLALL	tolerance on c nvergence at error matrix
T.2	fam face total temperature, for nonstandard days (°R)
124	duct-burner exit temperature, when ductburning (°R)
<u>'</u>	conbustor exit/turbine inlet temperature (°R)
T4DS	combustor exit/turbine inlet temperature at design (°R)
T '	afterburner exit temperature, when afterburning (°R)
Wr A	afterburner fuel flow rate, IAFTBN=2 (lbm/sec)
WFB	main combustor fuel flow rate, MODE=2 (1bm/sec)
WFBDS	combustor fuel flow rate at design, MODE=2 (1bm/sec)
VFD	duct burner fuel flow rate, IDBURN=2 (1bm/sec)
ZCDS, ZFDS, ZIDS	design ratio of high pressure compressor, fan, and intermediate compressor respectively; equals pressure ratio at design on design speed line minus one divided by high(surge) value minus one on the design speed line

# OUTPUT SYMPOLS

Some symbols, such at T, are followed by station numbers; see station number symbols

# In addition to all input symbols, the following are output:

A	areas (ft <sup>2</sup> )
AM	Mach numbers
BLDU	total bleed flow into duct (1bm/sec)
BLDUC	<pre>bleed flow into duct from high-pressure compressor (lbm/sec)</pre>
BLDUI	bleed flow into duct from intermediate compressor (1bm/sec)
BLC	high-pressure compressor bleed flow (1bm/sec)
BLF	fan bleed flow, overboard (1bm/sec)
BLHP	total bleed flow to high-pressure turbine (lbm/sec)
3LHPC	high-pressure turbine cooling bleed from high- pressure compressor (lbm/sec)
BLHPI	high-pressure turbine cooling bleed from intermediate compressor (lbm/sec)
BLI	intermediate compressor bleed blow (1bm/sec)
BLIP	total bleed flow to intermediate turbine (lbm/sec)
BLIPC	intermediate turbine cooling bleed from high- pressure compressor (1bm/sec)
BLIPI	intermediate turbine cooling bleed from intermediate compressor (lbm/sec)
BLLP	total bleed flow to low-pressure turbine (lbm/sec)
BLLPC	low-pressure turbine cocling bleed from high- pressure compressor (1bm/sec)
BLLPI	low-pressure turbine cooling bleed from intermediate compressor (lbm/sec)
BLOB	total overboard bleed flow (lbm/sec)
BLOBC	overboard bleed flow from high-pressure compressor (1bm/sec)
BLOBI	overboard bleed flow from intermediate compressor (1bm/sec)

BYPASS	bypass ratio, duct airflow divided by intermediate compressor airflow
CNC	high pressure compressor corrected shaft speed as a percent
CNF	fan corrected shaft speed as a percent
CNHP	high pressure turbine corrected shaft speed as a percent, $PCNC/\sqrt{T4}$
CNHPCF	high pressure turbine speed correction factor
CNI	intermediate compressor corrected speed as a percent
CNIP	intermediate turbine corrected shaft speed as a percent, PCNI/ $\sqrt{T45}$
CNIPCF	intermediate turbine speed correction factor
CNLP	low-pressure turbine corrected shaft speed as a percent, PCNF/ $\sqrt{T5}$
CNLPCF	low-pressure turbine speed correction factor
CS	ambient speed at sound (ft/sec)
DHHPCF	high-pressure turbine work correction factor
DHIPCF	intermediate turbine work correction factor
DHLPCF	low-pressure turbine work correction factor
DHTC	high-pressure turbine work, AH, (Btu/1bm)
DHTCHP	high-pressure turbine work, temperature corrected, $\Delta  \text{H/T}$ (Btu/lbm $^{\circ}\text{R}$ )
DHTCIP	intermediate turbine work, temperature corrected, $\Delta H/T$ (Btu/1bm °R)
DHTCLP	low-pressure turbine work, temperature corrected, $\Delta H/T$ (Btu/1bm °R)
DHTF	low-pressure turbine work, AH (Btu/1bm)
DHTI	intermediate turbine work, ΔH (Btu/lbm)
DPAFT	afterburner/tailpipe pressure, loss, $\Delta P/P$
DPCOM	combustor pressure loss, $\Delta P/P$
DPDUC	fan duct pressure loss, AP/P

DTAFCF afte	erburner temperatur	e rise correct	ion factor
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DTAFDS afterburner temperature rise at design,  $\Delta$ T (°R)

DTCOCF Combustor temperature rise correction factor

DTDUCF duct-burner temperature rise correction factor

DTDUDS duct-burner temperature rise at design, AT (°R)

ETAACF afterburner efficiency correction factor

ETAADS afterburner efficiency at design

ETAB combustor efficiency

ETABCF combustor efficiency correction factor

ETAC high-pressure compressor adiabatic efficiency

ETACCF high-pressure compressor efficiency correction factor

ETAD ductburner efficiency

ETADCF duct burner efficiency correction factor

ETADDS ductburner efficiency at design

ETAF fan adiabatic efficiency

ETAFCF fan efficiency correction factor

ETAI intermediate compressor adiabatic efficiency

ETAICF intermediate compressor efficiency correction factor

ETATHP high-pressure turbine adiabatic efficiency

ETATIP intermediate turbine adiabatic efficiency

ETATLP low-pressure turbine adiabatic efficiency

ETHPCF high-pressure turbine efficiency correction factor

ETIPCF intermediate turbine efficiency correction factor

ETLPCF low-pressure turbine efficiency correction factor

FAR fuel-air ratios

FART total fuel-air ratio

FG gross thrust (1bf)

FGM momentum thrust, total (lbf)

FGMD momentum thrust from duct (1bf)

FGMM momentum thrust from core (lbf)

FGP total pressure thrust (1bf)

FGPD pressure thrust from duct (1bf)

FGPM pressure thrust from core (1bf)

FN net thrust (lbf)

FRD ram drag (1bf)

H enthalpies (Btu/lbm)

P total pressures (atm)

PCNC high-pressure compressor shaft speed as a percent

PCNCGU first guess of PCNC

PCNF fan shaft speed as a percent

PCNFGU first guess at PCNF

PCNI intermediate compressor shaft speed as a percent

PCNIGU first guess at PCNI

PRC high pressure compressor pressure ratio

PRCCF high pressure compressor pressure ratio

correction factor

PRF fan pressure ratio

PRFCT fan pressure ratio correction factor

PRI intermediate compresser pressure ratio

PRICF intermediate compressor pressure ratio correction

factor

ps static pressures (atm)

S entropies (Btu/1bm - R)

SFC specific fuel consumption (lbm/lbf/hr)

T total temperatures (°R)

TS static temperatures

T2DS fan face total temperature at design (°R)

T21DS fan exit total temperature at design (°R)

T22DS intermediate compressor exit total temperature

at design (°R)

T24DS ductburner exit temperature at design (°R)

T7DS afterburner exit temperature at design (°R)

T4GU first guess at T4 (°R)

TFFHP high-pressure turbine flow function

TFFIP intermediate turbine flow function

TFFLP low-pressure turbine flow function

TFHPCF high-pressure turbine flow function correction factor

TFIPCF intermediate turbine flow function correction factor

TFLPCF low-pressure turbine flow function correction factor

velocities (ft/sec)

VA aircraft velocity (ft/sec)

VJD fan duct exhaust velocity (ft/sec)

VJM core exhaust velocity (ft/sec)

WA airflows (1bm/sec)

WAC high-pressure compressor airflow (1bm/sec)

WACC high-pressure compressor corrected airflow (1bm/sec)

WACCF high-pressure compressor airflow correction factor

WACDS high-pressure compressor airflow at design (lbm/sec)

WAD duct airflow (1bm/sec)

WAF fan airflow (1bm/sec)

WAFC fan corrected airflow (lbm/sec)

WAFCF fan airflow correction factor

WAI intermediate compressor airflow (1bm/sec)

WAIC intermediate compressor corrected airflow (lbm/sec)

WAICT intermediate compressor airflow correction factor

WA3CDS high-pressure compressor exit corrected airflow

at design (1bm/sec)

WA23CDS ductburner entrance corrected airflow at design (lbm/sec)

WFADS afterburner fuel flow rate at design (1bm/sec)

WFDDS ductburner fuel flow rate at design (lbm/sec)

WFT total fuel flow rate (lbm/sec)

WGT total gas flow rate (1bm/sec)

WG6CDS afterburner entrance corrected gas flow at design

(1bm/sec)

ZC, ZF, ZI similar to ZCDS, ZFDS, and ZIDS except these

are off-design - see Input Symbols

# SECTION I

## INTRODUCTION

In 1967, a digital computer program for balancing cycle turbofan engines titled SMOTE was developed in the Air Force Aero Propulsion Laboratory (Reference 1). This program is capable of simulating design and off-design performance of two-spool turbofan engines. This report describes a similar technique, obtained by modifying the SMOTE program, that simulates design and off-design performance of three-spool turbofan engines. NASA, Pratt and Whitney, General Electric and other contractors have developed or are developing working models that simulate the performance of three spool engines. However, through the experience gained in developing an in-house computer program, more flexibility can be exercised in making modifications to satisfy varying future needs without being dependent on contractors or other organizations.

Three-spool turbofan engines will be competitive as candidates for powering future aircraft systems. This effort has provided the Air Force Aero Propulsion Laboratory with an in-house method for evaluating the peformance of three-spool turbofan engines.

# SECTION II

#### **SUMMARY**

A computer program titled TRISPL is described. This program is derived from SMOTE (Simulation of Turbofan Engine) which was developed by the Turbine Engine Division of the AF Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio.

TRISPL calculates design and off-design performance of 3-spool turbofan engines. Component maps, input as block data, are scaled internally to simulate a specific engine. The program is formulated for two core spools and one fan spool operation. Options are included for mixed or separate flow engines and dry or afterburning operation. The program can be modified for different modes of operation and engine types, 2 fan spools and one core spool for example.

#### SECTION III

## METHOD OF ENGINE CALCULATIONS

The following discussion is very similar to that in the report describing the SMOTE program.

## 1. COMPONENT MAPS

The performance of the major engine components is based on component maps. These maps are usually obtained from analytical methods or rig-testing and are then converted into Block Data subroutines for use by TRISPL. The maps presently included in TRISPL are very general and do not represent any particular engine or engine components.

The component maps are scaled at the engine design point by TRISPL in order to match their performance to a desired set of performance figures which are input as data. Scaling or correction factors are calculated and then applied to the maps at off-design points. The scaling process is linear; therefore, correction factors near unity result in the highest accuracy of component simulation. Conversely, however, not being close to 1.0 does not necessarily mean that the simulation is poor since many maps have been shown to be typical over quite large ranges in the variables.

TRISPL presently includes component maps for the fan, intermediate compressor, high pressure compressor, combustor, and the three turbines. Duct burning, duct losses, gas mixing, afterburning, tailpipe losses, and nozzle losses are all calculated or input, but these characteristics could also be included as Block Data if maps were available. Likewise, schedules for bleed air and variable area nozzles could be used.

# a. Fan-Compressor Maps

The fan and compressor maps are very similar and are plots of pressure ratio vs. corrected airflow with constant corrected speed lines and constant efficiency islands (see Fig. 1). Entry to the map is through the corrected speed and Z, where Z is a ratio of pressure ratios, and is defined at a constant corrected speed as shown in Figure 1. It is advantageous to use Z instead of pressure ratio because Z is restrained between the limits of O and 1, whereas the limits on pressure ratio vary depending upon map location and the particular map. Also, as indication that the fan or a compressor is approaching surge is given as Z approaches 1.

# b. Combustor Map

The combustor map is a plot of efficiency vs. temperature rise for constant input pressure (see Fig. 2). Entry to the map is through temperature rise and input pressure, with efficiency being output.

# c. Turbine Maps

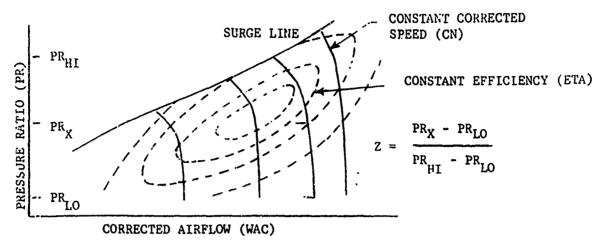
The turbine map is a plot of work function vs, corrected speed with constant turbine flow function lines and constant efficiency islands (see Fig. 3). The work function and flow function are defined as

$$DHTC = \frac{H_{IN} - H_{OUT}}{T_{IN}}$$

and

$$\frac{\text{WG}_{\text{IN}}\sqrt{\text{T}_{\text{IN}}}}{\text{P}_{\text{IN}}}$$

Entry to the map is through corrected speed and flow function, with work function and efficiency being output.



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Figure 1. Example of Fan-Compressor Map

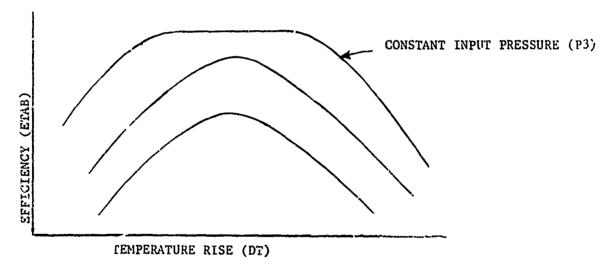


Figure 2. Example of Combustor Map

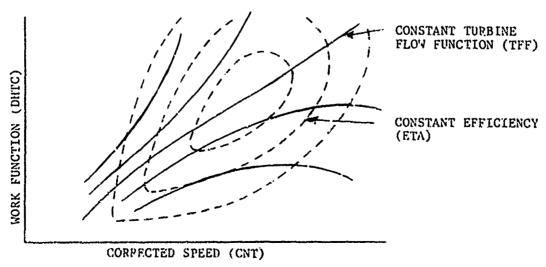


Figure 3. Example of "urbine Map

是是是这种的,我们就是这个人,他们就是这种的,也不是这种的,我们就是这种的,我们就是这种的,我们就是这种的,我们就是这种的,我们就是这种的,我们就是这种的,我们

The work function could have been used as an entry in place of one of the present entries, but, because of the shape of the curves, this could lead to double entry points for one work function. However, if the turbine maps were plotted in a different format, this could be an acceptable method.

## 2. DESIGN POINT

Once the component maps have been reduced to Block Data form and placed in the program, it is necessary to run a design point. The design point is run at those conditions under which the real engine is designed or sized, often sea level static. Design parameters necessary to simulate the real engine (for example, airflow, bypass ratio, turbine inlet temperature, various pressure losses, pressure ratios, etc.) are input and a complete thermodynamic cycle calculation is performed. For more details on the cycle calculation see Section III 4, "Off-Design Points". Scale factors for the component maps are calculated to insure that the input design parameters are met. If the design parameters have been correctly input, the design point will be completed after one pass through the engine calculations (that is, no balancing will occur) because the maps are shifted to reduce the errors to zero.

Other parameters calculated and output at the design point include certain temperatures, airflows, gas mixing areas, and nozzle throat and exit areas.

#### 3. SCALING FACTORS

Scaling or correction factors are calculated at the design point using the following equation:

P (correction factor) = P (design)/P (map)
where P represents a general parameter. One exception to this equation

is the equation for calculating the fan and compressors pressure correction factors:

PR (correction factor) = [PR (design) - 1]/[PR (map) - 1]where PR represents a general pressure ratio.

Theoretically, if the component maps and the input design parameters are exact representations of a particular engine, the correction factors will equal 1. However, this will not be true due to map interpolations, certain assumptions such as ideal and isentropic flow, and tolerances in the thermodynamic calculations. If unmatched component maps are used, the correction factors can differ significantly from 1.

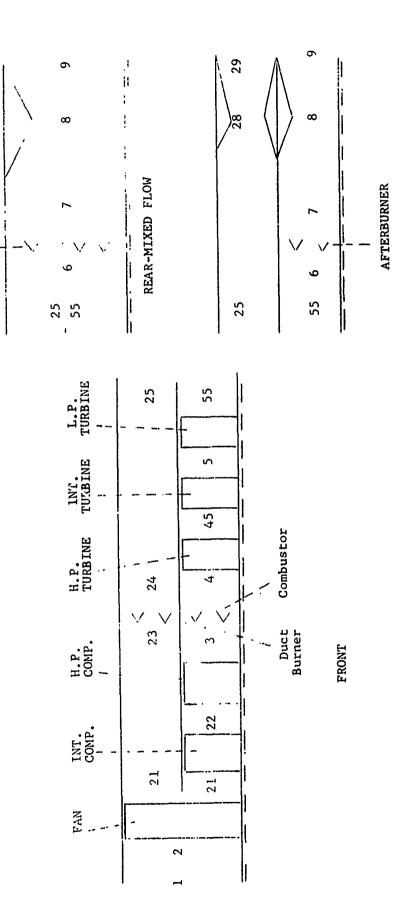
# 4. OFF-DESIGN POINTS

The following discussion pertains particularly to off-design points, although the input and the general cycle calculations are the same for the design point. Throughout the following discussion, it should be remembered that scaling or correction factors (multipliers) are applied to all performance maps (Block Data parameters). A schematic diagram of the engine components and station designations is shown in Fig. 4.

#### a. Input

The program uses a controlled output; that is, the variables desired as output can be selected at the start of a run. This selection is obtained by placing the names of the variables in the first section of input cards. Controls, scaling factors and operating conditions make up the rest of the input.

The control inputs are used to determine the type of engine; mixed or separate flow, afterburning or duct burning, and convergent or convergent-divergent nozzle. The controls are also used to fix the



AFTERBURNER

Figure 4. Schematic of Engine Components

REAR-SEPARATE FLOW

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mode of operation; constant PCNF, constant PCNC, constant T4, or constant WFB. Other controls determine inlet conditions, title printout, and cycle looping printouts. The correction factors can be input directly, or the design point can be run first and the coculated factors will be stored in common. The operating conditions include the flight Mach number, altitude, power setting (either PCNF, PCNC, T4, or WFB), duct burner and afterburner temperatures or fuel flows, bleed, and horsepower extraction.

## b. Initial Values

The program uses six primary independent variables: ZF,

PCNF, ZI, PCNI, ZC, PCNC (T4 may be substituted for PCNF or PCNC,

depending upon the mode of operation). Three secondary independent

variables (TFFHP, TFFIP, and TFFLP) are also used to ensure correct

entry into the turbine maps. Initial values for these nine variables

must be obtained to start the program at each point. A subroutine (GUESS)

supplies these variables as a function of T2, T21, and some of the

variables themselves. It is important to note that the closer the

initial values are to the final values at a balanced point, the

faster the program will run. Therefore, after a particular engine

configuration has been run a few times, it is usually advisable to change

the general initial value equations to suit the engine, using the knowledge

gained from past runs to estimate more closely the final values of

the variables.

## c. Inlet

The thermodynamic properties of the atmosphere are found from a 1962 ARDC Atmosphere Tables subroutine. Using conservation of energy and isentropic flow, the conditions at the face of the fan can be found. A ram recovery can be input or, if not input, a ram recovery defined by MIL-E-5008E Specifications will be used. If desired, a T2-P2 direct input mode is available as are provisions for nonstandard day conditions.

# d. Fan and Compressor

Block Data is used to determine the performance characteristics of the fan and compressors. When Z and PCN are known, the pressure ratio, corrected airflow and efficiency can be found by using a general Block Data interpolation routine named SEARCH. With the pressure ratio known and when the assumption of isentropic compression and the efficiency are used, the thermodynamic conditions at the exit of the fan and compressors can be calculated. Bleed for consumer use, leakage, or cooling is accounted for. Actual airflow leaving the fan and compressors is calculated from corrected airflow, temperature, pressure, and bleed.

It should be mentioned here that the present form of TRISPL calculates corrected speed (CN) in a manner slightly different from SMOTE.

TRISPL uses an equation which forces corrected speed (CN) to equal physical shaft speed (PCN) at the design point. The equation is

$$CN = (PCN/\sqrt{\bar{e}}) \cdot \sqrt{\bar{e}}_D$$

where  $\theta$  is corrected temperature, and  $\theta_D$  is the corrected temperature at design. Thus, at the design point, CN = PCN. This equation is useful for studying theoretical engines where actual maps are not available but must be changed back to the SMOTE equation if real engines are to be simulated. SMOTE uses this equation:  $CN = PCN/\theta$ .

#### e. Combustor

The pressure drop in the combustor is a function of a design pressure drop and ratio of corrected airflow to design corrected airflow.

Combustor efficiency is obtained from Block Data using SEARCH. The fuel used is assumed to be JP-4 (at 59°F), and, with the assumption of adiabatic and constant pressure combustion, a fuel heating value equation as a function of T4 has been derived. Thus the fuel/air ratio, fuel flow, and thermodynamic conditions at the combustor exit can be calculated.

If WFB is known instead of T4, a small iteration is necessary.

## f. Turbines

The turbine subroutines all use similar logic and obtain their performance characteristics from Block Data using subroutine SEARCH. All three turbine parameters (CN, TFF, DHTC) can be calculated before entering the turbine map, but only two are needed. Therefore, the third parameter obtained from the map is compared with the calculated third parameter, and a balancing error is generated if they are not equal. In this program, CN and TFF are used for map entries, and DHTC is used to generate the error. In addition, the efficiency is also obtained through SEARCH.

In addition, another error will be generated if TFF is not within map limits. The error will be the difference between TFF and the nearest map limit. This error becomes particularly important when the estimated initial values of the independent variables are far from the correct values, and the point is extremely unbalanced. When either TFF or CN is not within map limits, they are set to the nearest map limit, and one of the independent variables is changed in an attempt to rectify the situation. The operating point must appear on all maps before a complete cycle calculation can be accomplished.

Horsepower extraction is accounted for in calculating DHTC of the high pressure turbine. When the efficiency is used and the turbine process is assumed isentropic, the thermodynamic properties at the three turbine exits can be calculated. Any bleed airflow for cooling the turbines is treated as if it entered the main stream behind the turbine, and the thermodynamic properties at the turbine exit are recalculated to account for this.

## g. Duct

The duct airflow and bypass ratio are calculated from the fan and intermediate compressor airflows. The pressure drop in the duct is treated as in the main combustor. For duct burning, the same fuel heating value equation that was used in the main combustor is again used, but the efficiency must be input. As in the combustor, either the temperature (T24) or the fuel flow (WFD) may be input.

If a separate flow engine is being simulated, the duct nozzle calculations are done in this routine, although they are accomplished in the same manner as for the main nozzle.

#### h. Mixer

The gas mixing areas (duct exit and turbine discharge for a mixed flow engine or just the turbine discharge area for a separate flow engine) are calculated at the design point using either an input core static pressure or Mach number. In the mixed flow mode, there is an option for calculating afterburner entrance area as a function of an input afterburner entrance Mach number at the design point. At an off-design point the areas are used to calculate static pressures and Mach numbers.

For a separate flow engine, the thermodynamic conditions entering the afterburner are now known, since they are identical to turbine discharge conditions.

For a mixed flow engine, a set of derived equations based on one-dimensional fluid flow theory and conservation of mass, energy, and mementum is used to determine the thermodynamic conditions after complete mixing of the two gas streams. These equations do not require that the static pressures of the two entering streams be equal. However, for a correct engine balance, the two static pressures must be equal, and a balancing error is generated if they are not equal.

## i. Afterburner

The dry loss (cold loss) pressure drop in the afterburner is a function of a design pressure drop and the ratio of corrected gas flow to the design corrected gas flow.

For afterburning, the same equation for the fuel heating value that was used in the combustor is again used, but the efficiency must be input. As in the combustor, either temperature (T2) or the fuel flow (WFA) may be input. A momentum loss (hot loss) pressure drop is also calculated.

#### i. Nozzle

The main nozzle program uses fixed effective areas (except when afterburning or when different nozzle areas are directly input) calculated at the design point. Either a convergent or convergent-divergent subroutine may be used depending upon the input controls. If afterburning has been selected, the nozzle areas are allowed to float to obtain optimum performance; however, the areas are returned to their original design values after the afterburning point is completed. Nozzle

areas can also be changed by directly inputting different nozzle area values. The duct nozzle behaves identically to the main nozzle, including floating areas if duct-burning has been selected.

Because all thermodynamic properties of the gas stream are known, as well as the amount of flow, nozzle areas, and ambient pressure, there is a redundant parameter. For this program, the total pressure of the gas stream was chosen as the redundant parameter. The nozzle calculations are made without using the total pressure, and a required total pressure compatible with all other known parameters is calculated. This required pressure is compared with the actual pressure and a balancing error is generated if they are not equal.

# k. Performance and Output

At this point, nine errors have been generated after one pass through the engine. Several more passes must be completed under control of the error matrix and engine balancing technique. See Section IV for a detailed description of the balancing technique. Eventually however, the errors will be reduced to zero, and engine performance will be calculated using standard equations. Gross thrust is obtained by summing the mementum term (a nozzle velocity coefficient may be input) and a pressure-area term, and the net thrust is in turn found by subtracting a ram drag (airflow momentum loss at inlet) term from the gross thrust. Specific fuel consumption (SFC) is total fuel flow divided by net thrust.

As previously mentioned, a controlled output is used, whereby only selected variables are printed. Each variable is labeled with its name and provisions have been made for changing the name of a variable. In addition, the values of all variables in common are printed in a close format so that variables other than those selected for a specific run are available later on.

# 5. CADRATIC INTERPOLATION ROUTINE

是是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也会会会是一个人, 第一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也 Throughout the program there are many small loops (for example, thermodynamic iterations and table look-up) which require convergence. Trial-and-error methods and linear interpolations can be time consuming. especially when a tight tolerance is necessary; therefore, a general interpolation routine called AFQUIR (Air Force Quadratic Interpolation Routine) (Reference 1) is used.

This routine requires a dummy array dimensioned for nine locations. Also input into the routine through the calling argument are the independent and the dependent variables, the answer or value which the dependent variable is to converge upon, the number of tries at convergence, the tolerance, and a variable called DIR.

The DIR is either set or calculated in the calling program and is an initial guess at the direction and percentage change to apply to the first value of the independent variable. If not enough is known about the variable to calculate DIR, an arbitrary value may be set. This should not affect the final result, but may increase the number of tries of convergence.

This value is used in the calling program to determine a corresponding second value of the dependent variable and AFQUIR is called a second time with two sets of values. A linear interpolation is made which results in a third value of the independent variable. AFQUIR is then called a third time with the third values of the independent and dependent variables and a quadratic interpolation is made. The values of these three sets of variables have been stored in the dummy array, and from hereon, quadratic

interpolations are made using the three sets which give values closest to the answer. Values farthest from the answer are lost.

Various safeguards are built into AFQUIR to return the interpolation method to DIR or linear if the roots of the quadratic become complex, if the quadratic does not intercept the answer, if the value of the independent variable differs radically from previous values, or if two sets of independent and dependent variables are identical.

Also it is possible to preload the dummy array directly at the linear or quadratic interpolations if desired.

In summary, AFQUIR is a completely flexible routine which performs . quadratic interpolation for quick convergence of general functions.

# SECTION IV

# BALANCING TECHNIQUE

The balancing technique is virtually the same as that used in SMOTE. It is based on finding a solution for a set of partial differential equations. For this program, the set is composed of nine equations; however, using a set of only three equations will simplify the following discussion. This corresponds to a basic single spool turbojet simulation. SMOTE uses a set of six equations.

As discussed previously, nine independent variables (ZF, PCNF or T4, ZI, PCNI, ZC, PCNC or T4, TFFHP, TFFIP, and TFFLP) were selected. Once these variables have been given initial values, it is possible to proceed through an entire engine cycle calculation. Nine errors are generated as shown in Section III. These initial values of the nine variables and nine errors are referred to as base values.

In the following equations, V refers to a variable and E to an error. The basic set of differential equations based on E = f(V) is

$$dE_1 = \frac{\partial E}{\partial V_1} 11 \ dV_1 + \frac{\partial E}{\partial V_2} 12 \ dV_2 + \frac{\partial E}{\partial V_3} 13 \ dV_3$$

$$dE_2 = \frac{\partial E}{\partial V_1} 21 \ dV_1 + \frac{\partial E}{\partial V_2} 22 \ dV_2 + \frac{\partial E}{\partial V_3} 23 \ dV_3$$

$$dE_3 = \frac{\partial E}{\partial V_1} 31 \ dV_1 + \frac{\partial E}{\partial V_2} 32 \ dV_2 + \frac{\partial E}{\partial V_3} 33 \ dV_3$$

where the single subscripts correspond to three variables and three errors and where the double subscripts indicate the change in a particular error (first subscript) due to a change in a particular variable (second subscript).

Assuming small changes result in the following approximations (where B refers to a base value):

$$\frac{\partial E}{\partial V} = \frac{\Delta E}{\Delta V}$$

With these approximations and the fact that E should be zero when the engine is balanced, the set of partial differential equations reduces to

$$E_1 - EB_1 = \frac{\Delta E_{11}}{\Delta V_1} dV_1 + \frac{\Delta E_{12}}{\Delta V_2} dV_2 + \frac{\Delta E_{13}}{\Delta V_3} dV_3 = - EB_1$$

$$E_2 - EB_2 = \frac{\Delta E_{21}}{\Delta V_1} dV_1 + \frac{\Delta E_{22}}{\Delta V_2} dV_2 + \frac{\Delta E_{23}}{\Delta V_3} dV_3 = -EB_2$$

$$E_3 - EB_3 = \frac{\Delta E_{31}}{\Delta V_1} dV_1 + \frac{\Delta E_{32}}{\Delta V_2} dV_2 + \frac{\Delta E_{33}}{\Delta V_3} dV_3 = - EB_3$$

Three more passes (nine for TRISPL) are now made through the engine cycle calculations, and one variable is changed by a small amount ( $\Delta V$ ) for each pass. The change in each error due to the small change in the variables ( $\Delta E/\Delta V$ ) can be calculated.

The above set of differential equations can now be solved for  $dV_1$ ,  $dV_2$  and  $dV_3$  and, in general, the new value of each independent variable would be given by

# V = VB + dV

If the engine cycle calculations were linear functions, the engine would balance (errors equal zero) with these new values of the variables. However, this is usually not the case. The new errors become base errors (still keeping the old  $\Delta E/\Delta V^{\dagger}s$ ) and another attempt at balance is performed. If several such attempts still fail, the entire process is repeated where the new errors and variables become base values and a new set of  $\Delta E/\Delta V^{\dagger}s$  are calculated.

A subroutine to determine the solution of a matrix is used to solve the set of differential equations. After each pass through the engine, a matrix array is loaded with the appropriate values; after ten passes (base value plus nine independent variables) the matrix subroutine is called to solve the matrix.

It was found that the "dV's" obtained from the solution of the differential equations were in many cases too large, thus causing the variables to exceed their limits, and to make it practically impossible to balance the cycle. The "dV's" are therefore multiplied by a suppression factor calculated in the program which limits the swing of the variables. Although this procedure may tend to increase the number of passes before balancing in some cases, it also balances points which previously would not balance. These points are most generally far from the design point, where oscillations of the dependent variables tend to build up.

### SECTION V

### INPUT/OUTPUT DESCRIPTIONS

# 1. BLOCK DATA INPUT

The three compressor maps are entered into the program as BLOCK DATA subprograms FANDAT, INTDAT, and CMPDAT.

Using FANDAT as an example (refer to program listing), and referring to typical map (Fig. 1), the data are programmed as follows:

Card 1 identifies the program as BLOCK DATA. Card 2 is a comment card.

Card 3 identifies the common block FAN into which data are to be stored and dimensions the program variables. Card 4 indicates that there are 10 speed lines N and the number of points NP on each line (6 on the lowest speed, 7 on the next 3 lines, etc). Card 5 assigns the value of speed to each of the 10 lines (low to high). The remaining cards indicate the values of pressure ratio (PR), corrected airflow (WAC), and efficiency (ETA) for the speed lines. For example, the card

PATA (PR (4,J), J = 1,7)/

denotes that the pressure ratios are for the 4th speed line (CN = 0.6) and that there are 7 points.

The combustor BLOCK DATA subprogram is CMBDAT. Referring to the program listing and a typical combustor map (Fig 2), the data are programmed as follows:

Card 1 identifies the program as BLOCK DATA. Card 2 identifies the common block COMB into which data are to be stored and dimensions the variables. Card 3 indicates that there are 15 lines of constant PSI(P3) by the value of N, and that there are 15 values of DELT (DT) and ETA(ETAB) along

each line of constant PSI(P3). Cards 4 and 5 assign values to each of the P3 lines from low to high pressure. Cards 6 to 8 assign values of  $\Delta T$  to each of the P3 lines starting at low  $\Delta T$ . The lowest value of  $\Delta T$  on each of  $\Delta T$  on the lowest value of P3. Next comes the second lowest value of  $\Delta T$  on each P3, etc. Cards 9 to 16 assign the value of ETAB in a one-to-one correspondence with the  $\Delta T$  values just assigned. The order is the same.

The turbine maps are the BLOCK DATA subprograms HTURB, ITURB, and LTURB. Taking HTURB as an example and referring to the program listing and a typical map (Fig. 3) the data are programmed as follows: Card 1 identifies the subprogram as BLOCK DATA. Card 2 is a COMMENT card. Card 3 identifies the common block HTURB into which data are to be loaded and dimensions the program variables. Card 4 indicates the number of constant turbine flow function lines TFF as 11 (N) and the number of points on each line from low to high TFF. Cards 5 and 6 set values of TFF from low to high. The remaining cards set the values of corrected speed (CN), work function (DH), and efficiency (ETA) starting from low TFF.

DATA (DH(5,J), J = 1,15)/

denotes that the work functions are for the 5th flow function line (TFF = 49.175) and that there are 15 points.

# 2. CONTROLLED OUTPUT/NAMELIST INPUT

The input data is divided into two sections; data cards for the controlled output, and data cards in Namelist format for running each point. For the following discussion on setting up input data, refer to the listing of sample data immediately following the program listing.

# a. Controlled Output

The variables that are to be output are selected by the first section of data cards. Any variable that is in one of the main commons (DESIGN, FRONT, SIDE, or BACK) may be selected for output by punching the name at the variable as it appears in the common (with trailing blanks if necessary) in Columns 1 throw 7. Up to 150 variables (25 lines of 6 variables) may be chosen for a particular run. During the output phase, the name of the variable is printed out, with its value printed immediately below the name.

Another feature of the controlled output is the ability to change the name of a variable to be output; for example, it may be desired to change a station designation to one more common to a particular programmer. In this case, the variable name would be punched in Columns 1 through 7 as described above, but in addition, the desired name would be punched in Columns 15 through 22. Special symbols, such as /, may be used in the new name. The last card of the controlled cuiput must be a card with THEEND punched in Columns 1 through 6.

In addition to the variables selected as controlled output, the values of all variables in common are printed in a close format so that variables other than those selected for a specific run are available later on.

## b. NAMELIST Input

The normal data for running the desired points follows the controlled output data and is in a Namelist format, where the name of the Namelist is DATAIN. Usually the first set of data is the design point, as shown in the sample input data. When the design point is run (DDES = 1), all map scaling or correction factors are printed out, as well as being retained

in common. Therefore, it is possible to run off-design points immediately following the design point by making use of the values in common, or to begin running an off-design point immediately by inputting the scaling or correction factors. The first method is usually easier, but the second method may be desired if many points are to be run using the same engine parameters with no changes except for power setting, Mach number, and altitude.

The variables that must be input at the design point for the basic cycle (for example, no afterburning) are listed in Table I below:

TABLE I

INPUTS REQUIRED FOR BASIC CYCLE AT DESIGN POINT

VARIABLE	DEFINITION	UNITS
PRFDS	Fan pressure ratio	
WAFDS	Fan face airflow	lb/sec
ETAFDS	Fan efficiency	
ZFDS	Design Z of fan	
PCNFDS	Fan shaft speed expressed as percent	
PRIDS	Intermediate compressor pressure ratio	
WAIDS	Intermediate compressor (core) airflow	lb/sec
ETAIDS	Intermediate compressor efficiency	
ZIDS	Design Z of intermediate compressor	•
PCNIDS	Intermediate compressor shaft speed as a percent	
PRCDS	High pressure compressor pressure ratio	
ETACDS	fligh pressure compressor efficiency	
ZCDS	Design Z of high pressure compressor	
PCNCDS	High pressure compressor shaft speed as a percent	
ETABDS	Combustor efficiency	
DPCODS	Combustor pressure drop, AP/P	
DTCODS	Combustor temperature rise	°R
T40S	Turbine inlet temperature	°R
TEHPDS	High pressure turbine flow function	lb√vR/(SFC)(p i
CNHPDS	High pressure turbine corrected speed	
ETHI'DS	High pressure turbine efficiency	
TFIPOS	Intermediate turbine flow function	1b√ <sup>8</sup> R/(SFC)(j <sup>m</sup> .

VARIABLE	DEFINITION	UNITS
CNIPDS	Intermediate turbine corrected speed	
ETIPDS	Intermediate turbine efficiency	
TFLPDS	Low pressure turbine flow function	lb√oR/(sec)(psia)
CNLPDS	Low pressure turbine corrected speed	
ETLPDS	Low pressure turbine efficiency	
DPDUDS	Fan duct pressure drop, $\Delta P/P$	
DPAFDS	Tailpipe pressure drop, △P/P	
AM55	Mach number at low pressure turbine exit	
PS55	Static pressure at low pressure turbing exit	atm
AM	Flight Mach number	
ALTP	Altitude	ft
HPEXI	Horsepower extraction	hp
CVMNOZ	Main nozzle velocity coefficient	
CADNOS	Duct nozzle velocity coefficient	
	+	
•	Various bleed flows (see Symbols)	

Various control parameters (see below)

As mentioned in Table I, various control parameters which fix the engine type, mode of operation, method of calculating ram recovery, etc. must be input. These are listed below. Subroutine ZERO determines what values in common will be zeroed between points. None of the design values or correction factors are zeroed but some of the control parameters are. In the control parameter listing below, the superscripts (1) to (4) have the following meanings: (1) an imatically returned to zero after

each point is calculated, must be re-input if option is again desired, (2) option can be used only at off-design points; (3) these input values remain as input unless changed by a new value; (4) a set-up case must be run where all the components are first matched before these  $\neq 0$  options are used, then the identical case may be repeated exercising these options.

```
(1)
   IDES = 1
                  For calculating design point
  MODE = 0
                  Specify T4
(2)
  MODE = 1
                  Specify PCNC
  MODE = 2
                  Specify WFB
(2)MODE = 3
                  Specify PCNF
  INIT = 0
                  Initializes point
  INIT = 1
                  Will not initialize point
            (3)
  IDUMP = 0
                  No looping write-outs
  IDUMP = 1
                 Will dump looping write-outs if error occurs
            (3)
  IDUMP = 2
                 Will dump looping write-outs after every point
            (3)
  IAMTP = 0
                 Will use AM and mil-spec ETAR
            (3)
  IAMTP = 1
                 Will use input AM and input ETAR
  IAMTP = 2
                 Will use input T2 as T1=T1+T2 and standard P1 (T2 value
                 needs to be input at every point or an error will occur
                 whenever used)
          (3)
  IAMTP = 3
                 Will use input P2 and standard T1
  IAMTP=4
                 Will use input T2 and input P2
          (3)
  IGASMX=0
                 Separate flow, A6=A55
```

(3)	
IGASMX=1 (3)	Will mix duct and main streams, A6=A25+A55
IGASMX=2	Will mix duct and main streams, input AM6
(4) (1) IDBURN=1	For duct burning, input T24
(4) (1) IDBURN=2	For duct burning input WFD
(4) (1) IAFTBN=1	For afterburning (mixed or unmixed streams), input
(4) (1) IAFTBN=2 (3)	For afterburning (mixed or unmixed streams), input WFA
IDCD=1	FAn duct nozzle will be convergent-divergent
IHCD=1	Main nozzle will be convergent-divergent
(4) (3) NOZFLT=1	For floating main nozzle exit area
(4) (3) NOZFLT=2	For floating duct nozzle exit area
(4) (3) NOZFLT=3	For floating duct and main nozzle exit areas
ITRYS=N	Number of passes through engine before quitting
TOLALL=X	Tolerance which the errors must satisfy before engine is matched
DELFG, DELFN, DELSFC (1)	Normally input as 1.0 unless a correction is desired
TTITLE=1	A title card must follow after the input data for this point (see below)

A title card must be input immediately after the first point of the data pack and ITITLE must be set equal to 1 in the data for the first point. This is because a title is always printed for each point and must therefore be previously defined. The input format for the title is 12A6 and the resulting 72 spaces are centered on the page when printed out. The title may be changed by setting ITITLE=1 and inserting a new title card after the Namelist data for the point.

# Off-Design Operation

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Shown in the sample input listing are methods of specifying off-design operation points. The user inputs the appropriate control parameters, Mach number, altitude and power setting other than design values (power setting being a value for T4, PCNC, PCNF, or WFB).

If the engine has all its nozzles fixed, then an input such as T4 or shaft speed will set the thrust level. Other means of changing engine operation can be accomplished by varying nozzle throat areas A8 and A28. For example, an off-design condition may exist where the operating point lies outside the limits of the block data input for a component map such as the fan. A nozzle throat area change could return the operating point back on the input map. It should be noted that an area remains changed until it is recalculated by a new design case or altered by a new input.

The nozzle exit area (A9 and/or A29) may be floated to obtain full expansion of using NOZFLT=1, 2 or 3 for non-afterburning cases.

To run duct burning (fan stream only), cases load ETAD, and either T24 or WFD. To run afterburning, cases load ETAA, T7 or WFB. When such a point is run, the exhaust nozzle areas are allowed to float to obtain optimum expansion. This means that there can be no balancing at the point, and it is necessary to prebalance the engine cycle in a nonaugmented mode. That is, an identical point, except that it is nonaugmented must be run before either afterburning or duct burning. When either IAFTBN or IDBURN is greater than zero, the program will automatically set INIT=1 and use the balanced values from the preceding point. The nozzle areas are returned to their original values after completing an augmented point. Some examples of afterburning are given in the samp¹e data listing.

### SECTION VI

## SUBROUTINE DESCRIPTIONS

A fl v chart of the computer program with the subroutines is shown in Figure 5. Listed here are brief descriptions of the subroutines.

TRISPL Dummy main program to initiate the calculations

and cause the input of the controlled output variables.

Because of the looping between subroutines, control

is never transferred back to this routine.

ENGBAL Main subroutine. Controls all engine balancing

loops, checks tolerances and number of loops and

loads matrix.

MATRIX Solves error matrix

INPUT Reads Namelist data and title. Prints title,

ZERO Zeroes common and certain controls

COINLT Determines ram recovery and performs inlet calculations

ATMOS 1962 US Standard Atmosphere table

RAM Calculates ram recovery defined by MIL-E-5008B

Specifications

GUESS Determines initial values of independent variables

(PCNF, PCNI, PCNC, and T4) at each point. It may be

desired to change these equations to suit a particular

engine. The closer the initial values are to the

final values, the faster the program will balance.

COFAN Uses BLOCK DATA to perform fan calculations

COINTC Uses BLOCK DATA to perform intermediate compressor

calculations.

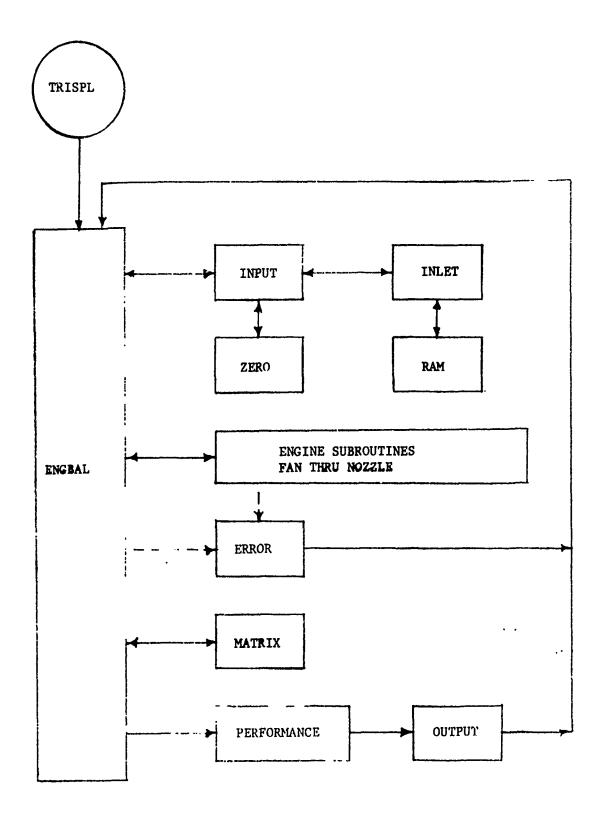


Figure 5. TRISPL Subroutine Flow Chart

COCOMP	Uses BLOCK DATA to perform high-pressure compressor
	calculations. Calculates ERR(7).
COCOMB	Uses BLOCK DATA to perform combustor calculations.
	May use either T4 or WFB as the main parameter.
СОНРТВ	Uses BLOCK DATA to perform high-pressure turbine
	calculations. Calculates ERR(1) and ERR(2).
COIPTB	Uses BLOCK DATA to perform intermediate turbine
	calculations. Calculates ERR(8) and ERR(9).
COLPTB	Uses BLOCK DATA to perform low-pressure turbine
	calculations. Calculates ERR(3) and ERR(4).
FRTOSD	Dummy routine to transfer values from common FRONT
	to common SIDE.
CODUCT	Performs duct and duct-burning calculations. May
•	use T24 or WFD as the main parameter for duct
	burning. Controls the duct nozzle and calculates ERR(*)
	if in separate-flow mode.
FASTBK	Dummy routine to transfer values from common FRONT
	and SIDE to common BACK.
COMIX	Performs gas mixing calculations if in mixed flow
	mode. At design points it calculates areas from
	either an input static pressure (PS55) or an input
	either an input static pressure (PS55) or an input Mach number (AM55) if PS55=0. Also, an option
	·
	Mach number (AM55) if PS55=0. Also, an option
	Mach number (AM55) if PS55=0. Also, an option exists where afterburner entrance area A6 is

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pressures and Mach numbers from the design areas.

Calculates ERR(5) if in mixed-flow mode.

COAFBN Performs afterburning calculations. May use either

T7 or WFA as the main parameter.

COMNOZ Controls the main nozzle and calculates ERR(6).

PERF Calculates performance after engine is balanced.

OUTPUT Prints output except for controlled output. Prints

the main commons in a close format after each point.

CONCUT Controls and prints the controlled output variables.

ERROR Controls all printouts if an error occurs. Prints

name of subroutine where error occurred and also

prints the values of all variables in the main commons.

Controls printing from UNITO8. Throughout the

program and particularly in ENGBAL, certain

messages, variables, and matrix values are written

on UNITO8 as an aid in determining why an error

occurred or why a point did not balance. These

values are printed out if subroutine ERROR is

called and IDUMP is greater than zero, or after

a good point if IDUMP=2.

TAPES Defines UNITO8, which is just a "scratch" disk

and does not require a \$SETUP card. Normal

input and output are on UNITO5 and UNITO6,

respectively.

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THCOMP Performs isentropic calculations for compressors.

THTURB Performs isentropic calculations for turbines.

THERMO Provides thermodynamic conditions using PROCOM.

PROCOM	Calculates thermodynamic gas properties for either
	air or a fuel-air mixture, based on JP-4.
SEARCH	General table lockup and interpolation routine to
	obtain data from Block Data routines.
MAPBAC	Used when calculations result in values not on the
	turbine maps. Changes the map value and an
	independent variable (PCNF, PCNC or T4) in an
	attempt to rectify the situation.
CONVRG	Performs nozzle calculations for a convergent nozzle.
CONDIV	Performs nozzle calculations for a convergent-divergent
	nozzle.
AFQUIR	General quadratic interpolation routine.
CMBDAT	Block Data for combustors.
FANDAT	Block Data for fan.
INTDAT	Block Data for intermediate compressor.
CMPDAT	Block Data for high-pressure compressor.
LTURB	Block Data for low-pressure turbine.
ITURB	Block Data for intermediate turbine.
HTURB	Block Data for high-pressure turbine.

# SECTION VII

# PROGRAM LISTING

The following is a complete listing of all subroutines required to run TRISPL.

PROGRAM TRISPL(INPUT,OUTPUT,TAPES=INPUT,TAPE6=OUTPUT,TAPE8)
CO MMON /POINT/ICATPT
ID ATPT=0
CALL CONOUT(1)
CALL ENGBAL
STOP
END

```
SUBROUTINE FRGBAL
 COMMON /
              hill
                                  , MODE
        ,IDES ,JOES
                          , KDES
1 NO RD
                                           , INIT
                                                    ,IDUMP ,IAHTP ,
                                  , IHCD
2 IG ASHX, IDBURN, IAFTBN, IDCD
                                           .IDSHOC.IMSHOC.NOZFLT.
3ITRYS,LOOPER,NOMAP,NUMMAP,MAPEDG,TOLALL,ERR(9)
 COMMON/DES IGN/
1PCRESU , PCNIGU , PCNGGU , T4GU
                                        ,DUMD1
                                                 .DELFG
                                                           DELFN
                                                                     .DELSFC
          ,PCNFDS ,PRFDS
                             , ETAFDS
                                                 PRFCF
2 ZF DS
                                       . WAFDS
                                                           , ETAFCF , WAFCF
3 ZI OS
          , PCNIDS
                   ,PRIDS
                             , ETAIDS
                                       SOIAN
                                                 ,FRICF
                                                           .ETAICF .WAICF
                   , PRC DS
                             , ETACDS
4 ZC DS
          , PCNCDS
                                                           , ETACCF , WACCF
                                       • PACDS
                                                 ,PRCCF
5 T4 DS
          , WF BDS
                    ,DTCODS ,ETABOS
                                       , WA3CDS
                                                 ,DPCODS ,DTCOCF
                                                                     .ETABCF
          . CN HPDS
                   ,ETHPDS
                                                           , DHHPCF
                                                                     ,T20S
6TF HPDS
                             .TFHPCF
                                       . CNHPCF
                                                 .ETHPCF
          , CNIFDS
                                       ,CNIPCF
7 TF IPDS
                    ,ETIPOS ,TFIPCF
                                                 ,ETIPCF , DHIPCF , T210S
8 TF LPDS
         , CNLPOS
                    ,ETLPOS , TFLPCF
                                       ,CNLPCF
                                                 ,ETLPCF , DHLPCF , T22DS
3 T2 4DS
          , WF DDS
                    ,OTDUDS , ETADDS
                                       , WAZ3DS
                                                 , OPDUDS , DTDUCF , ETAD CF
AT7 DS
          , WF ADS
                    , OTAFDS , ETAADS
                                       , WG6CDS
                                                 ,DPAFDS ,DTAFCF
                                                                    , ETAACF
B A55
                             , A7
          , A25
                    , A6
                                       ,A8
                                                 ,A9
                                                           .A28
                                                                     . A29
C PS 55
                                                                     ,AZ9SAV
          , AM 55
                    ,CVDNOZ oCVMNOZ
                                       , ASSAV
                                                           ,A28SAV
                                                  ,A9SAV
 COMMON/ FRONT/
          , P1
1 T1
                    ,H1
                             ,51
                                                 .P2
                                       ,T2
                                                           , H2
                                                                     ,52
2721
          , P21
                    , H21
                             ,521
                                       , T22
                                                 ,P22
                                                                     ,522
                                                           ,H22
          , P3
                                                 ,P4
3 T3
                    £H3
                             ,53
                                       ,T4
                                                                     ,54
                                                           ,H4
          , P45
4T45
                    , H45
                              ·S45
                                       ,T5
                                                 .P5
                                                           , H5
                                                                     ,55
5 T5 5
          . P55
                    , H55
                             ,355
                                       , BLF
                                                           , BLC
                                                 .BLI
                                                                     , BLOU
          , PRF
                    , ETAF
                             , HAFC
                                       , HAF
6 CN F
                                                 ,BLDUI
                                                           , BLDUC
                                                                     BLOB
7 CNI
          . PRI
                    ,ETAI
                             , HAIC
                                       , HAI
                                                           ,BLOSC
                                                                     , HA3
                                                 ,BLOBI
                                       , HAC
8 CNC
          , PRC
                    ,ETAC
                             , HACC
                                                 ,ETAB
                                                           , DPCOH
                                                                     , WG4
          , ET ATHP
9 CN HP
                    , DHT CHP
                             , DHTC
                                       , BLHP
                                                                     ,FAR4
                                                 ,BLHPI
                                                           , BLHPC
A CN IP
          , ET AT IP
                    , DHT CIP
                                                                     , DUMF
                             . DHTI
                                       , BLIP
                                                 ,BLIPI
                                                           , BLIPC
          , ET AT LF
                    , DHT CLP
BCNLP
                             , DHTF
                                       ,BLLP
                                                 ,BLLPI
                                                           , BLLPC
                                                                     • CS
C NG 45
          ,FAR45
                    , HG5
                             ,FAR5
                                       , #G55
                                                           , HPEXT
                                                                     , AM
                                                 ,FAR55
DALTP
          , ET AR
                    , ZF
                             , PCNF
                                                           ,ZC
                                                                     , PCNC
                                       ,ZI
                                                 ,PCNI
          ,TFFH#
                    ,TFFIP
                             , TFFLP
EWFE
                                       , PCBLF
                                                                     ,PCBLOUI,
                                                 ,PCBLI
                                                           , PCBLC
FPCBLOUC, PCBLOBI, PGBLOBC, PCBLHPI, PCBLHPC, PCBLIPI, PCBLIPC, PCBLLPI.
GPCBLLFC
 COMMON/
            SIDE/
          , XHAF
                    , XWAI
1 XP1
                                       , XBLF
                             , XHAC
                                                 ,XBLDU
                                                           , XBLOUI , X8LOUC
2 XH 22
                    ,XT21
                             , XP21
          EHX.
                                       , XH21
                                                 .XS21
                                                           , DUMS1
                                                                     ,DUMS2
          , P23
                    ,H23
                             , $23
3 T2 3
                                       ,T24
                                                 ,P24
                                                           , H24
                                                                     ,524
4 T2 5
          .P25
                    , H25
                             ,S25
                                       , T28
                                                 ,P28
                                                           ,H28
                                                                     . $28
5 T2 9
          ,P29
                    ,H29
                                                           , DUMS 5
                                                                     , DUMS 5
                             , S29
                                       . DUMS3
                                                 .DUMS4
                    , HG24
                             ,FAR24
6 NA D
          , WFD
                                                           , BYPASS
                                       ,ETAU
                                                 , DPDUC
                                                                     , DUMS 7
          , PS 28
7 TS 28
                    , V28
                              BSHA,
                                       ,TS29
                                                 ,PS29
                                                           , V29
                                                                     , AM29
 COMMON /
             BACK/
                          ,XS55
                                  , XT25
                 ,XH55
                                                  , XH25
X XT 55
        , XP55
                                           , XP25
                                                            ,XS25
X XHFB
        , X KG 55
                 ,XFAR55,XWFD
                                  ,XWG24 ,XFAR24,XXP1
                                                            , DUMB
3 16
         , P6
                 ,H6
                          ,56
                                  , T7
                                           , P7
                                                    ,H7
                                                            ,57
                          ,58
                                  ,T9
                                           , P9
4 T8
         .Pe
                 ,H8
                                                   , H9
                                                            ,59
5 KG6
         , HFA
                 ,WG7
                          ,FAR7
                                  , ETAA
                                           DPAFT , V55
                                                            , V25
6 FS 6
        ,46
                 ,AM6
                          ,TS7
                                                   ,AH7
                                  ,PS7
                                           , V7
                                                            , AH25
        ,PS8
                 , V8
                                  ,TS9
                                                   , V9
7 15 8
                                           ,PS9
                          ,AM8
                                                            , AM9
         ,FRD
                 , VJC
A VA
                          ,FGMD
                                  , VJH
                                                    , FGPD
                                           , FGHM
                                                            , FGPM
9 KS H
        , F GP
                          , WGT
                 ,WFT
                                                    , FN
                                  , FART
                                           • FG
                                                            .SFC
 DIMENSION DELSAY (9)
 DIMENSION VAR(9), DEL(9), ERRB(9), DELVAR(9), EMAT(9,9), VMAT(9),
```

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```
1 AM AT (9)
      DATA DELSAY/9*.001/
      DATA AWORD/6HENGBAL/
      DATA VDELTA, VLIM, VCHNGE, NOMISX/
     1 0.001,0.100,0.850,4/
      DATA DEL/9+0./
      CALL INPUT
      IF (INIT.EQ.1) GG TO 50
      TFFHP=TFHPDS
      TFFIP=TFIPOS
      TFFLP=TFLPDS
50
      LOOPER=0
      NU MM AP=0
      NOMISS=0
      LO OP = 0
1
      MI SMAT=0
      NO MAP=0
      IG 0=2
      DO 2 I=1,9
      VM AT ( I ) = 0.
      AM AT (I) = D.
      DELVAR(I)=0.
      00 2 L=1,9
      EM AT (I, L) = 0.
2
      LOGPER=LOOPER+1
      CALL COFAN
      HO RD = AWO RD
      IF (LOOPER. GT. ITRYS) GO TO 20
      IF (NOMAP.GT.O) GO TO 1
      NU MHAP=0
      VAR(1)=ZF*100.
55
       IF (MODE.NE.3) VAR(2)=PCNF
      IF (MODE.EQ.3) VAR(2) #T4/18.
       VAR(3)=ZC+100.
       IF (MODE.NE.1) VAR(4)=PCNC
       IF (MODE.EQ.4) VAR(4)=T4/10.
       VAR(5)=TFFHP
       VAR(6)=TFFLP
       VAR(7)=ZI#100.
       VAR(8)=PCNI
       VAR(9)=TEFIP
       CO 4 I=1.9
       IF (ABS(ERR(I)).GT.TQLALL) GO TC 5
    4 CONTINUE
       CALL PERF
       GALL ERROR
       IF (LOCP.GT.O) GC TO 7
       MAPEDG=0
       MAPSET=1
       00 6 I=1,9
       ERRB(I) = ERR(I)
       DEL(I)=VDELT#FVAR(I)
6
       GO TO 9
       IF (HISHAT. GT. 0) GO TO 30
7
       IF (MAPEDG.EQ.8) GG TO 70
```

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```
MA PEDG=0
      M4 PSET=1
      VAR(LOOP) = VAR(LOOP) +2. +DEL(LOOP)
      GO TO 10
      IF (MAPSET.EQ.O) VAR (LOOP)=VAR (LOOP) +DEL (LOOP)
70
      IF (MAPSET. EQ.1) VAR (LOOP) = VAR (LOOF) - DEL (LOOP)
      MAPSET=0
      DO 8 I=1.9
      IF (BEL(LOOF) .NE.O.) DELSAV(LOOP) = DEL(LOOP)
      IF (DEL(LCOF) . EQ.O.) DEL(LOOP) = DELSAV(LOOP)
      EMAT(I,LOOF) = (ERRB(I) - ERR(I))/DEL(LOOP)
8
      LOOF=LOOP+1
      IF (LOCP. GT.9) GO TO 11
      VAR(LOOP) = VAR(LOOP) -DEL(LOOP)
      ZF=VAR(1)/100.
10
      IF (MODE. NE.3) PCNF=VAR(2)
      IF (MODE.EQ.3) T4=VAR(2)+10.
      ZC=VAR(3)/100.
      IF (MODE.NE.1) PCNC=VAR(4)
      IF (MODE.EQ.1) T4=VAR(4)+10.
      TFFHP=VAR(5)
      TFFLP=VAR(6)
      ZI=VAR(7)/100.
      PCHI=VAR(8)
      TFFIP=VAR(9)
      IF(Zf.LT.0.) ZF=0.05
      IF (ZIaLY.O.) ZI=0.05
      IF (ZC.LT.0.) ZC=0.05
      GO TO (1,3), IGO
      00 12 I=1.9
 11
      AMAT(I)=-ERRB(I)
12
      00 14 I=1,9
      IZERO*0
      DO 13 LOOP=1,9
13
      IF (EMAT(I, LOOP) .EQ. Q.) IZERO=IZERG+1
      IF(IZERO.LT.9) GO TO 14
      HRITE (6, 100) I
      LOOPER TTRYS + 100
      go 10 20
      CONTINUE
14
      00 16 LOOP=1.9
      IZERO=0
      00 15 X=1,5
15
      IF (EHAT(I.LOCP).EQ.G.) IZERO=IZERC+1
      IF (IZERO.LT.9) GO YO 16
      WRITE (6, 101) LCCP
      LOOPER=ITRYS+100
      GO TO 20
      CONTINUE
18
      CALL MATRIX(EMAT, VMAT, AMAT)
17
      LB IG * 0
      VARBIG=0.0
      CO 18 1=1,9
      ABSVAK#ABS (VMAT (L))
      IF (ABSVAR.LE.VLIM*VAR(L)) GO TO 18
```

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```
IF (ABSVAP. LE. VARBIG) SQ TO 18
      LBIG=L
      VARBIG=ABS VAR
      CONTINUE
18
      VRATIC=1.0
      IF (LBIG.GT.0) VRATIO=VLIN+VAR(LBIG)/VARBIG
      ERRAVE=C.O
      VMTAVE=0.0
      DELAVE=0.0
      DO 19 L=1.9
      DELVAR(L) = VRATIO+VMAT(L)
      ERRAVE=ERRAVE+ABS(AMAT(L))
      VM TA VE=VMTAVE+ABS(VMAT(L))
      DELAVE=DELAVE+AES(DELVAR(L))
19
      VAR(L)=VAR(L)+DELVAR(L)
      ERRAVES9.
      VMTAVE=VMTAVE/9.
      CELAVE=DELAVE/9.
      IF (MISMAT.GT.O) GO TO 32
      IF (NOMISS. EQ. 0) MISMAT=1
      IF (MISMAT. EQ. 0) IGO=1
20
      WRITE(8,102) LOOPER
      00 21 I=1.9
 21
      HRITE(8,103) AMAT(I),(EMAT(I,L),L=1,9),VMAT(I),DELVAR(I),VAR(I)
      WRITE(8,104) ERRAYE, VMTAVE, DELAVE
22
      IF (LOOPER.LT.ITRYS) GO TO 10
      CALL ERROR
      RETURN
30
      VMTAVX=VMTAVE
      00 31 I=1.9
31
      AMAT(I)=-ERR(I)
      GO TO 17
32
      WRITE(8,105) AMAT, ERRAVE, DELVAR, DELAVE, VMAT, VMTAVE, VAR
      MI SMAT=MISFAT+1
      IF (VMTAVE.LT. VCHNGE VMTAVX) GO TO 22
      HRITE(8.105)
      IF (HISHAT. LT. NOMISX) NOMISS=1
      MI SMAT=0
      LOOP = 0
      IG 0=2
      GO TO 55
      FORMAT(4HDROb, 12, 16H IS ZERO IN EMAT)
100
      FORMAT (7HO COLUMN, 12, 16H IS ZERO IN EMAT)
101
      FORMAT (7HC
                   ERRB, 31 X23 HERROR MATRIX AFTER LOOP, 14, 31 X4HVMAT,
     16X6HOELVAR, 7X10HVARIABLESS)
      FORMAT(1H0,F7.3,9F9.3,4XF9.3,3XF10.4,4XF11.4)
 1.03
      FORMAT(1HQ,F8,4,32X14HAVERAGE VALUES,31X,2F11.4;5H$$$$$)
 105
      FORMAT(12H0---- AMAT, 10F11.6, 6H$$$$$$,
              12H ---- DEL VAR, 10F11.6, 6H$$$$$$,
     1/,
              12H ----
                          VMAT, 10F11.6, 6H$$$$$$;
              12H ----
                           VAR, 9F11.6, 6H$1$$$$)
      FORMAT(1H0,56X22HCHANGE TOO SMALL$$$$$$)
106
      EN ()
```

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```
SUBROUTINE INPUT
 DIMENSION TITLE (12)
 COMMON /POINT/IDATPT
 COMMON /
              ALL/
        , IDES
                        ,KDES
                                           , INIT , IDUMP , IAHTP ,
1 WORD
                , JOES
                                  , MODE
2 IG ASMX, IDBURN, IAFTBN, IDCD , IMCD , IDSHOC, IMSHOC, NOZFLT,
3 ITRYS, LOOPER, NOMAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
 COMMON/DES IGN/
                                       , DUMD1
                                                           , DELFN
                                                                     , DELSFC
1PCNFGU , PCNIGU , PCNCGU , T4GU
                                                 ,DELFG
                                                 ,PRFCF
                             , ETAFDS
                                       , HAFDS
                                                           ,ETAFCF
                                                                    , WAFCF
         ,PCNFDS ,PRFBS
2 ZF DS
                                                                    , WAICF
                                                           ,ETAICF
                             , ETAIDS , WAIDS
                                                 ,PRICF
3 ZI OS
         ,PCNIDS ,FRIDS
                             , ETACDS , HACDS
                                                           , ETACCF , HACCF
4 ZC 0S
         ,PCNCDS ,PRCDS
                                                 ,PRCCF
                    ,DTCODS ,ETABDS , WASCOS ,DPCODS ,DTCOCF ,ETABCF
         , WF BDS
5 T4 DS
6TFHPDS , CNHPDS , ETHPDS , TFHPCF , CNHPCF
                                                ,ETHPCF ,DHHPCF ,T20S
                   ,ETIPOS ,TFIPCF ,CNIPCF
                                                          , DHIPCF
                                                                    ,T210S
                                                 , ET IPCF
7TFIPOS , CNIPOS
                                       ,CNLPCF
                            ,TFLPCF
                                                          , DHLPCF
                                                                    ,T220S
STFLPDS , CNLPDS , ETLPDS
                                                 ,ETLPCF
         , WFODS
                    ,DTDUDS
                            ,ETADDS , WA23CS
                                                 , DPDUOS , DTDUCF , ETADOF
9 T2 4DS
                    ,DTAFDS ,ETAADS ,NG6CDS
                                                 , DPAFDS , DTAFCF
                                                                    ,ETAACF
AT7 DS
          , WF ADS
                             , A7
                                       , A 8
                                                 ,49
                    , A6
                                                           ,A28
                                                                     ,A29
B A55
          , A25
                    , CVDNOZ
                                                 ,A9SAV
CPS 55
          , AN 55
                            ,CVHNOZ ,A8SAV
                                                           ,A28SAV
                                                                     , A29SAV
 COMMON/ FRENT/
         , Pi
                                       ,T2
                                                 ,P2
                             ,51
                                                           , H2
                                                                     ,52
                    , H1
1 T1
                             , S21
                                       ,T22
                                                 ,P22
         , P21
                    ,H21
                                                           , H22
                                                                     , $22
2721
         , P3
                                       , 74
                                                                     ,54
                    , H3
                             , $3
                                                 ,P4
                                                           , H4
313
                                       ,T5
                                                           , H5
         , P45
                             ,545
                                                                     ,S5
                                                 ,P5
4145
                    , H45
         , P55
                                       , BLF
                                                 ,BLI
                                                           , BLC
5155
                    , H55
                             , S55
                                                                     .BLDU
                                       , WAF
                                                 ,BLDUI
                                                           , BLDUC
          , PRF
                             , HAFC
                                                                     , BLOB
6 CN F
                    , ETAF
                                       , WAI
                                                 ,BLOBI
                                                           , BLOBC
                                                                     ,WA3
7 CN I
          , PRI
                    ETAI
                             , WAIC
          , PRC
                    , ETAC
                             , WACC
                                       , HAC
                                                 ,ETAB
                                                           , DPCGH
                                                                     , HG4
8 CN C
                                       , BLHP
                             , DHTC
                                                 ,BLHPI
                                                           , BLHPC
                                                                     .FAR4
9 CN HP
          , ET ATHP
                    , DHTCHP
                    , DHTCIP
                                       ,BLIP
                             , DHTI
                                                 ,BLIPI
                                                           , BL IPC
                                                                     , DUMF
A CN IP
          , ET AT IP
          , ET ATLP
                    , DHT CLP
                             , OHTF
                                       , BLLP
BCNLP
                                                 ,8LLPI
                                                           , BLLPC
                                                                     , CS
                                                           , HPEXT
                    , NG5
                                       , HG55
                                                                     , AH
C NG 45
          ,FAR45
                              ,FAR5
                                                 ,FAR55
                                                                     , PCNC
                    , ZF
                             , PCNF
                                       ,21
                                                 ,PCNI
                                                           , ZC
GALTP
          , ET AR
                                       ,PCBLF
                             , TFFLP
                    , TFF IP
                                                 ,PCBLI
                                                           ,PCBLC
                                                                     , PCBL DUI,
ENFB
          , TF FHF
FFC8LDUC,FC8LC8I,PC8LO8C,PC8LHFI,PC8LHPC,PC8LIFI,PC8LIPC,PC8LLPI,
GPC BLLPC
 COMMON/
            SIDE
                             , XHAC
                                       , XELF
1 XP1
          , XHAF
                    , XHAI
                                                 ,XBLDU
                                                           ,XBLDUI ,XBLDUC
                             , XP21
                                       , XH21
                                                 .XS21
                                                           , DUMS1
                                                                     , DUMS 2
          , XH3
2 XH 22
                    , XT21
          ,P23
                             ,523
                                                 ,P24
                    ,H23
                                       , 124
                                                           , H24
                                                                     ,524
3T23
                                       ,T28
                                                 ,P28
                                                           ,H28
                                                                     ,528
          , P25
                    , H25
                             , $25
4125
                                                                     , DUNS 6
                    ,H29
                                       ,DUMS3
                                                           ,DUMS5
5 T2 9
          , P29
                             ,529
                                                 DUMS4
                                       ,ETAD
          , HFC
                    , HG24
                             ,FAR24
                                                 , OPDUC
6 HA D
                                                           ,BYPASS ,DUNS7
          , FS 28
                    , V26
7 TS 28
                              , AH28
                                        ,1529
                                                  ,PS29
                                                           , V29
                                                                     , AH29
             BACK/
 COMMON /
         , XP55
                 ,XK55
                          ,XS55
                                  , XT 25
                                           , XP25
                                                            , XS25
X X7 55
                                                    , XH25
                 ,XFAR55,XHFD
XXXFB
                                   ,XHG24 ,XFAR24,XXP1
                                                            .DUMB
         . X NG 55
        ,P6
                 , 46
                                           , P7
                          ,56
                                   ,17
                                                    ,H7
                                                            ,57
3 16
                                           , P9
        2 P 8
                 ,H8
                                   ,19
                                                    , H9
                                                            ,59
                          ,58
4 T8
                          ,FAR7
                                   , ET AA
                                           , DPAFT
                                                    , V55
                                                            , V25
         . HFA
                 , HG7
5 NG 6
                                           , V7
                                                    ,AM7
                          ,TS7
                                   ,PS7
6 PS 6
         . 46
                 ,AM6
                                                            , AM25
                                                    , V9
                 , ¥8
                                   ,TS9
                                           , FS9
7 TS 8
         ,PS8
                          ,AH8
                                                            , AMS
                                           , FGHM
                                                    ,FGPO
         ,FRO
                 , VJD
                          ,FGHD
                                   ,VJH
                                                            ,FGFH
8 VA
         , F GP
                 , WET
                          , WGT
                                           , FG
                                                    , FN
9 FGH
                                   "FART
                                                             ,SFC
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A series of the series of the

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NAMELIST/DATAIN/ IEND,
                                , INIT
     AITITLE , IDES
                                         , I CUMP
                        , MODE
                                                  , IAHTP
                                                           , IGASHX ,
     BIOBURN , IAFTEN , ICCO
                                , INCO
                                         ,NCZFLT ,ITRYS
                                                           , TOLALL
     C ZF DS
              ,PCNFDS ,PRFDS
                                , ETAFDS , WAFDS
                                                  ,PRFCF
                                                           .ETAFCF
                                                                    • WAFCF
              , PCNIQS , PRIDS
                                , ETAIDS , WAIDS
                                                   .PRICF
                                                           , ETAICF
                                                                    , WAICF
     E ZC DS
               , PCNCCS , FRCDS
                                                           ,ETACCF
                                 . ETACOS
                                                   PRCCF
                                                                    , HACCF
     FT4DS
               , WF EDS
                       , DTC ODS
                                ,ETABDS
                                         , HA3CDS
                                                  , OPCODS , DTCOCF
                                                                    .ETABCF
      GTFHPDS
              , CN HPOS , ETHPOS , TFHPCF , CNHPCF , ETHPCF , DHHPCF , T2DS
     HTFIPOS , CNIPOS , ETIPOS , TFIPCF , CNIPCF , ETIPCF , DHIPCF , T210S
     ITFLPCS , CNLPCS , ETLPOS , TFLPCF , CNLPCF , ETLPCF , DHLPCF
                                                                    ,T220S
      JT24DS
              , WFUOS
                        , DTDUDS , ETADOS , NA23DS , OPDUDS , DTDUCF , ETADOF
     KT7 DS
               , HF ADS
                        , DTAFOS , ETAADS , NG6CDS , DPAFDS , DTAFCF , ETAACF
     L A55
              , A25
                        , A6
                                , A7
                                         ,A8
                                                                    ,A29
                                                  ,A9
                                                           ,A28
     MT2
              . P2
                                , ZF
                                         , PCNF
                        ,T4
                                                           , ZC
                                                  ,ZI
                                                                    , PCNC
     NWFB
              , TF FHP
                        ,TFFIP
                                , TFFLP
                                         , AH
                                                  ,ALTP
                                                           ,ETAR
                                                                    , HPEXT
     OPCBLF
              , BL F
                       , PCBLI
                                ,BLI
                                         ,PCBLC
                                                  ,BLC
                                                           , PCBL DUI, PCBL BUC,
              , BL DUC
                       ,PCBLOBI,PCBLOBC,BLOBI
                                                  ,BLOBC
                                                           ,PCBLHPI,PCBLHPC,
     QPCBLIPI, PCBLIPC, PCBLLFI, PCBLLPC, BLHPI
                                                  ,BLHPC
                                                           , BLIFI
                                                                    BLIPC
     RELLPI
              ,BLLPC
                       ,PS55
                                , AM55
                                         , AP6
                                                  ,T24
                                                           ,ETAD
                                                                    , HFD
              , ET AA
     S 17
                        , NFA
                                ,CVDNOZ ,CVMNOZ ,DELFG
                                                                    , DELSFC
                                                           ,DELFN
       DATA IEND/O/
       IT ITLE=1
                  WILL READ IN TITLE
       IDES
                  FOR CALCULATING DESIGN POINT
             =1
       HODE
             = 0
                  FOR CONSTANT T4
                  FOR CONSTANT PCNC
       MODE
             =1
C
       MODE
             =2
                  FOR CONSTANT WFB
C
       MODE
             ≈3
                  FOR CONSTANT PCNF
C
       INIT
             =1
                  WILL NOT INITIALIZE POINT
C
       IDUMP =1
                  HILL DUMP LOOPING WRITE-OUTS IF ERRCR OCCURS
      ID UMP -2
                  WILL DUMP LOOPING WRITE-OUTS AFTER EVERY POINT
C
                  WILL USE INPUT AN AND MIL SPEC ETAR
C
       IAMTP =0
       IAMTP =1
                  HILL USE INPUT AN AND INPUT ETAR
      IANTP =2
                  WILL USE T2 AS T1=T1+T2 AND STANDARD P1
C
      IAMTP =3
                  WILL USE P2 AND STANDARG T1
C
       IAMTP =4
                  HILL USE T2 AND P2
      IG ASMX=0
                  SEPARATE FLOW, A6=A55
                  HILL MIX DUCT AND MAIN STREAMS, A6=A25+A55
       IGASHX=1
                  WILL HIX DUCT AND MAIN STREAMS, INPUT AM6
       IG ASM X=2
       ID BURN=1
                 FOR DUCT BURNING, INPUT T24
                 FOR DUCT BURNING, INPUT WFO
      IDBURN=2
C
                  FOR AFTERBURNING, INPUT T7
       IAFTBN=1
      IAFTBN=2
                 FOR AFTERBURNING, INPUT WFA
                 CUCT NOZZLE WILL BE C-D
      IDCO
            = 1
C
      IMCO
            =1
                 MAIN NOZZLE WILL BE C-D
      NO ZFLT=1
                 FOR FLOATING MAIN NOZZLE
 *** NOZFLT=2
۲.
                 FOR FLOATING DUCT NOZZLE
 *** NOZFLT=3
C
                 FOR FLOATING HAIN AND DUCT NOZZLES
C ***
                 NUMBER OF PASSES THRU ENGINE BEFORE QUITTING
      ITRYS = N
      CATA AHORD/6H INPUT/
      IDATPI=ICATFT+1
      CALL ZERO
      HORD = AHORD
      RE AD (5, DAT AIN)
      IF (IEND.NE.O) STOP
      CALL REMARK(14HNEW DATA POINT)
```

AND THE PROPERTY OF THE PROPER

,这种人,我们是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是 第二个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也是一个人,我们也

```
IF (IAFTBN. GT. 0. OR. IDBURN. GT. 0) INIT=1
      IF (ITITLE.EQ.1) READ(5,101) TITLE
      IT ITLE=0
      WRITE(6,102) TITLÉ
      IF (MODE.EQ.O) WRITE (8,103) IDES, AM, ALTP, T4 , T24, T7
      IF (MODE.EQ.1) WRITE 15,104) IDES, AM, ALTP, PCNC, T24, T7
      IF (MODE.EQ.2) WRITE (8,105) IDES, AH, ALTP, WFB, T24, T7
      IF (MODE.EQ.3) WRITE (8,106) IDES, AM. ALTP, PCNF, T24, T7
      CALL COINLT
      RETURN
      FORMAT (12A6)
101
      FORMAT (1H1,30X12A6)
102
      FORMAT(1H0,7H IDES=,I3,10X7H AM=,F7.3,6X7H ALTP=,F7.0,
103
              T4=, F8.2, 5X7H T24=, F8.2, 5X7H T7=, F8.2, 6H$$$$$$)
     1.6X7H
      FORMAT(1H0,7H IDES=,13,10X7H AM=,F7.3,6X7H ALTP=,F7.0,
104
     1.6X7H PCNC=,F8.3,5X7H T24=,F8.2,5X7H T7=,F8.2,6H$$$$$$)
      FORMAT(1H0,7H IDES=,I3,10X7H AM=,F7.3,6X7H ALTP=,F7.0,
105
           WFB=,F8.4,5X7H T24=,F8.2,5X7H T7=,F8.2,6H$$$$$$}
     1.6X7H
      FORMAT(1H0,7H IDES=,13,10X7H AM=,F7.3,6X7H ALTP=,F7.0,
106
     16X7H PCNF=,F8.3,5X7H T24=,F8.2,5X7H T7=,F8.2,6H$$$$$$)
      END
```

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```
SUBROUTINE ZERO
  COMMON /
               ALL/
         , IDES
                  ,JOES
                         ,KDES
                                  , MODE , INIT , IDUMP , IAMTP ,
2 IG AS MX, I DB URN, I AFTBN, I DCD , I MCD , I DS HOC, I MS HOC, NOZFLT,
 3 IT RYS, LOOPER, NOMAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
  COMMON/ FRONT/
                              ,51
                                                  , P2
          , P1
                                        ,T2
                                                                      ,52
171
                     ,H1
                                                            ,H2
           , P21
                              ,521
                                        ,T22
                                                  ,P22
2 T21
                     , H21
                                                            ,H22
                                                                      ,522
          ,P3
                                        ,T4
                                                  P4
                              ,53
313
                     , H3
                                                            . H4
                                                                      ,54
           , F45
                                                  ,P5
                     , H45
                               , 545
                                                                      ,55
4 T45
                                        , T5
                                                            , H5
           ,P55
                                        , BLF
                                                                      , BLDU
                     , H55
                                                  ,BLI
 5 155
                              , S55
                                                            , BLC
                                        , HAF
          , PRF
                               , WAFC
                                                  ,BLDUI
                                                            , BLDUC
6 CNF
                     , ETAF
                                                                      , BLOB
7 CN I
           , PRI
                     , ETAI
                               , WAIC
                                        , HAI
                                                  ,BLOBI
                                                            , BL OBC
                                                                      , HA3
                     , ETAC
                                        , HAC
                                                  ,ETAB
                                                            , DPCOM
                                                                      , WG4
8 CNC
          , PRC
                              , WACC
           , ET ATHP
                     , DHT CHP
                              , DHTC
                                        ,BLHP
                                                  ,BLHPI
                                                                      ,FAR4
9 CN HP
                                                            ,BLHPC
ACNIP
                              , DHTI
                                        , BLIP
           , ETATIP
                     , DHTCIP
                                                  ,BLIPI
                                                                      , DUHF
                                                            ,BLIPC
                             , DHTF
                    , DHT CLP
BCNLP
           , ET ATLP
                                        ,BLLP
                                                  BLLPI
                                                            .BLLPC
                                                                      •CS
                    , HG5
                              ,FAR5
                                        , HG55
                                                            , HPEXT
                                                                      , AH
           ,FAR45
                                                  ,FAR55
C WG 45
DALTP
           , ET AR
                     , ZF
                               , PCNF
                                        , Z I
                                                  ,PCNI
                                                            , ZC
                                                                      , PCNC
           ,TFFHF
                     , TFF IP
                              ,TFFLP
                                        ,PCBLF
                                                  ,PCBLI
                                                            ,PCBLC
EWFB
                                                                      ,PCBL DUI,
FPCBLOUC, PCBLCBI, PCBLOBC, PCBLHPI, PCBLHPC, PCBLIFI, PCBLIPC, PCBLLPI,
 G PC BLLPC
  COMMON
             SIDE/
          , XH AF
                     , XHAI
                                        , XBLF
                                                  ,XIILDU
1 XP 1
                              , XWAC
                                                            ,XBLOUI ,XBLDUC
                              , XP21
                                         , XH21
           , XH3
                     , XT21
                                                            , DUMS1
                                                                      ,DUHS2
 2 XH 22
                                                  , 7.521
                              ,523
           , P23
                                                  ,024
                                                            ,H24
                                                                      ,524
 3 T2 3
                     ,H23
                                        ,T24
                     ,H25
 4T25
           , P25
                               , S25
                                        ,T28
                                                  ,P28
                                                            .H28
                                                                      ,528
5 T2 9
           , P29
                     ,H29
                              ,529
                                        ,DUMS3
                                                  ,DUMS4
                                                            ,DUMS5
                                                                      , DUNS 6
6 WAD
                     , NG24
                              ,FAR24
                                        ,ETAD
                                                  , OPDUC
                                                            ,BYPASS ,DUMS7
           , NF D
                     , V28
          , PS 28
                               , AM28
                                        ,TS29
7 TS 28
                                                  ,PS29
                                                            , V29
                                                                      , AH29
  COMMON /
              EACK/
                          ,XS55
                  ,XH55
                                   ,XT25
                                            , XP25
X XT 55
         , XP55
                                                    ,XH25
                                                              ,XS25
                                   ,XWG24 ,XFAR24,XXP1
                                                              , DUMB
 XXWFB
         , X HG 55
                  ,XFAR55,XWFD
                                   ,T7
                           ,56
                                            , P7
                                                     ,H7
                                                              ,S7
         , P6
                  ,H6
 316
                           ,58
                                   ,T9
                                                     , H9
                                                             ,59
 4 T8
         ,P8
                  ,H8
                                            , P9
                           ,FAR7
                                   , ETAA
                                            , DPAFT , V55
                                                              ,V25
 5 NG 6
         , HFA
                  ,HG7
                                                     ,AH7
                  ,AM6
                           ,TS7
                                   ,PS7
                                            , V7
                                                              , AM25
 6 PS 6
         , V6
         ,PS8
                                            ,PS9
                                                     , 49
 7 TS 8
                  , V8
                           ,AM8
                                   , TS9
                                                              , AM9
                                            , FGMH
                                                     , FGPC
                                                              , FGPM
         ,FRO
 8 VA
                  ,VJD
                           ,FGHO
                                   ,VJH
                           , HGT
         , FGP
                                   ,FART
                                            ,FG
                                                     ,FN
                                                              ,SFC
 9 FG N
                  , HFT
  DIMENSION Z1 (94), Z2 (56), Z3 (72)
  EQUIVALENCE (21(1), T1), (22(1), XP1), (23(1), XT55)
  GATA ISTART/0/
  ISTART=ISTART+1
  IDES=0
  JDES=0
  INIT=0
  IDBURN=0
  IAFTBN=0
  IDSHOC=3
  IMSHOC=3
  IF (ISTART. NE.1) GO TO 4
  ZERO FRONT, SIDE, AND BACK INITIALLY TO PREVENT CDC 6600 MODE ERRORS
  00 5 I=1,94
5 Z1(I)=0.
```

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是是一种,我们就是这种的的的,我们就是一种的一种,我们就是一种的一种的,我们就是一种的一种的,我们也是一种的,我们就是一种,我们就是一种的一种,我们就是一种的一种,

00 6 I=1,56 6 Z2 (I) =0. 00 7 I=1,72 7 23 (1)=0. CALL SYG(1) RETURN 4 CONTINUE T2Q=T2 F2 Q=P2 14 Q= 1 4 DO 1 I=1,94 Z1(I)=0. 1 00 2 I=1,56 Z2 (I) = 0. 2 00 3 I=1,72 23 (1)=0. 3 12=T2Q P2=P2Q T4=T40 CALL SYG (1) RETURN END

```
SUBROUTINE CCINLT
 COMMON /
              ALL/
                        , KDES
                                        , INIT
1 NO RD
        , IDES
                , JOES
                                 , NODE
                                                 , IDUMP , IAMTP ,
2 IG ASHX, IDBURN, IAFTBN, IDCD
                                , IMCD
                                         , IDSHOC, IMSHOC, NOZFLT,
3 IT RYS, LOOPER, NOMAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
 COMMON/DESIGN/
                                      , CUMD1
1PCNFGU , PCNIGU , PCNCGU , T4GU
                                               ,DELFG
                                                         . DELFN
                                                                   ,DELSFC ,
                            DETAFOS , HAFDS
                                               ,PRFCF
2 ZF OS
         , PC NF OS , PRF OS
                                                         , ETAFCF , WAFCF
                                                ,PRICF
                                                         , ETAICF , WAICF
                            , ETAIDS , WAIDS
3 ZI OS
         ,PCNIDS ,PRIDS
                                                , PRCCF
                            , ETACOS
                                                         , ETACCF
                                                                  , WACCF
4 ZCDS
         , PCNCDS , PRCDS
                                      , WACDS
                                      , WASCOS
                                                ,DPCODS ,DTCOCF
                            , ETABOS
         , HF EGS
                   , DTC CDS
                                                                  ,ETABCF
5 T4 DS
                                                        , DHHPCF
                                               ,ETHPCF
                                                                  ,T2DS
6TFHPDS , CNHPDS , ETHPDS , TFHPCF , CNHPCF
                                      ,CNIPCF
7 TFIPOS , CNIPOS , ETIPOS , TFIPCF
                                               ,ETIPCF ,DHIPCF ,T210S
8 TFLPDS , CNLPDS , ETLPDS , TFLPCF , CNLPCF , ETLPCF , DHLPCF , T220S
                   , OTDUDS , ETADOS , MA23DS , OPDUDS , OTDUCF , ETADCF
9T24DS
         . WF DDS
                            , ETAADS , HGGCDS , DPAFDS , DTAFCF , ETAACF
AT70S
          . HF ADS
                   .OTAFOS
                                                         , A28
                                                                   ,A29
                   , A6
                            , A7
                                      , 48
                                                , A9
8 A5 5
          , A25
                                                ,A9SAV
                                                         ,A28SAV ,A29SAV
CPS 55
                   ,CVDNOZ ,CVHNOZ ,A8SAV
          , AH 55
 COMMON/ FRCNT/
                                      ,T2
                                                ,P2
                                                                   ,52
                                                         . H2
                   , H1
                             , S1
1 11
          , P1
                   ,H21
                                                ,P22
         ,P21
                            ·S21
                                      ,T22
                                                         ,H22
                                                                   , S22
2121
                                      ,14
                                                ,P4
                   ,H3
                            ,53
                                                                   ,54
                                                         . H4
3 1 3
          , P3
                                                                   , S5
                                      ,TE
                                                         , H5
                   , H45
                                                , P5
          ,P45
                             ,545
4T45
                                                                   , BLOU
                                                         , BLC
                   , H55
                            ,555
                                      ,BLF
                                                ,BLI
5155
          .P55
                                      , HAF
                                                         , BLDUC
                   , ETAF
                             , HAFC
                                                , BL DUI
                                                                   , BLOB
6 CN F
          , PRF
                                      , WAI
                                                , BLOBI
          , PRI
                   ,ETAI
                             , WAIC
                                                         , BLOBC
                                                                   , WA3
7 CN I
                                                                   , HG4
                                      , HAC
                                                ,ETAB
                                                         , DPCOM
         , PRC
                   ,ETAC
                            , WACC
8 CN C
                                                                   .FAR4
          , ETATHP
                   , DHTCHP , DHTC
                                                ,BLHPI
                                                         , BLHPC
                                      ,BLHP
9 CN HP
                   , DHT CIP
                            , DHTI
                                      , BLIP
                                                ,BLIPI
                                                         , BLIPC
                                                                   , DUMF
A CN IP
          , ETATIP
                   , DHT CLP
                            , DHTE
                                      , BLLP
                                                ,BI.LPI
                                                         .BLLPC
                                                                   , CS
BCNLP
          , ET ATLP
                             , FAR ?
                                                         , HPEXT
                                                .FAR55
                                                                   , 4M
C #G 45
          ,FAR45
                   , HG5
                                      . WG55
                                                                   , PCNC
                   , ZF
                             , PCh.
                                      ,ZI
DALTP
          , ETAR
                                                ,PCNI
                                                         , ZC
                                                         ,PCBLC
                   ,TFFIP
                             , TFFLP
                                      ,PCBLF
                                                ,PCBLI
                                                                   , PCBL DUI,
          , TF FHP
EWF8
FPC BL DUC.PC BLOBI,PCBLOBC.PCBLHPI,PCBLHPC.PCBLIPI,PCBLIPC,PCBLLPI,
 DATA AHORD/6HCOINLT/
 HORD = AWORD
 AJ=778.26
 G= 32.174049
 ALT=ALTP+2.0855531E+07/(2.0855531E+07-ALTP)
 CALL ATHOS (ALT, T1, XX1, XX2, XX3, P1, CS, XX4, IIER)
  IF (IAPTP.EG.2) T1=T1+T2
 IF (IAHTP.NE.1) CALL RAM(AM, ETAR)
 FAR=0.0
 LALL FROCOM(FAR, T1, CS, XX2, XX3, R1, FHI1, H1)
  S1 =PHI1-R1 +ALCG (F1)
 H2=H1+(AN+CS)++2/(2.+AJ+G)
 P2 T=1.
 00 2 I=1,10
  CALL THERM C(P2T, H2, T2T, S2T, AN, 0, 0.0, 1)
  IF (ABS(S2T-S1).LE.0.0001*S1) GO TC 3
 P2T=P1*EXP((AW/1.986375)*((S2T-S1)+(1.986375/AW)*ALOG(P2T/P1)))
 CALL ERROR
  RETURN
  IF (IAPTP.EG.3.OR.IAMTP.EQ.4) ETAR=P2/P2T
```

S

```
P2=ETAR*P2T
IF (IAHTP.NE.4) CALL THERMO(P2,H2,T2,S2,XX5,C,0.0,1)
IF (IAHTP.EQ.4) CALL THERMO(P2,H2,T2,S2,XX5,0,0.0,0)
IF (INIT.EQ.1) GO TO 6
IF (IDES.EQ.1) GO TO 4
IF (MODE.EQ.3) GO TO 5
PC NF=GUESS (MCOE,T4,T4DS,PCNC,PCNCDS,WFB,WFBDS,T2,T2DS,PCNFOS)
PC NFGU=PCNF
GO TO 5
PC NF=PCNFDS
PC NFGU=PCNF
T2 DS=T2
ZF=ZFOS
RETURN
END
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SUBROUTINE ATMOS (ZFT, TM, SIGHA, PHO, THETA, DELTA, CA, AMU, K)
    THIS IS A SUBROUTINE TO COMPUTE CERTAIN ELEMENTS OF THE 1962
C
C
    U.S. STANDARD ATMOSPHERE UP TO 90 KILOMETERS.
C
     CALLING SEQUENCE...
C
C
     CALL ATNOS (ZFT, TM, SIGNA, RHO, THETA, DELTA, CA, AHU, K)
C
                    GEOMETRIC ALTITUDE (FEET)
C
                    MOLECULAR SCALE TEMPERATURE (DEGREES RANKINE)
C
          SIGMA =
                    RATIO OF DENSITY TO THAT AT SEA LEVEL
          RHO
                    DENSITY (LB-SEC++2-FT++(-4)
                                                    OR
                                                         SLUGS-FT++3)
C
                    RATIO OF TEMPERATURE TO THAT AT SEA LEVEL
          THETA =
C
                    RATIO OF PRESSURE TO THAT AT SEA LEVEL
C
          CA
                    SPEED OF SOUND (FT/SEC)
C
          AMU
                    VISCOSITY COEFFICIENT (LB-SEC/FT++2)
                =
C
C
          K = 1 NORMAL
C
            = 2 ALTITUDE LESS THAN -5000 METERS OR GREATER THAN 90 KM
C
            = 3 FLCATING POINT OVERFLOW
C
C
    ALL DATA AND FUNDAMENTAL CONSTANTS ARE IN THE METRIC SYSTEM AS
C
    THESE QUANTITIES ARE DEFINED AS EXACT IN THIS SYSTEM.
C
C
    THE RADIUS OF THE EARTH (REFTS9) IS THE VALUE ASSOCIATED WITH THE
C
    1959 ARDC ATMOSPHERE SO THAT PROGRAMS CURRENTLY USING THE LIBRARY
    ROUTINE WILL NOT REQUIRE ALTERATION TO USE THIS ROUTINE.
      DIMENSION HB (10), THB (10), DELTAB (10), ALM (10)
      DATA(HB(I),I=1,10)/-5.,0.,11.,20.,32.,47.,52.,61.,79.,88.743?
      DATA (TMB(I), I=1,10) /320.65,288.15,216.65,216.65,228.65,270.65;
     1 270.65, 252.55, 180.65, 180.65/
      DATA (DELTA E 4 I) ( 1=1, 10) /1.75363 1. ,2.23361E-01,5.40328E-02,
     1 8.56663E-03,1.09455E-03,5.82289E-04,1.79718E-04,1.0241E-05,
     2 1.6223E-06/
      DATA (ALH (I), I=1,10)/-6,5,-6.5,0.,1.,2.8,0.,-2.,-4c,0.,0./
                                         /9,80665/,
      DATA REFT59/2.0855531E 07/, GZ
                                 /, RSTAR /8,31432/,
                  128.9644
            FTTOKH/3.048E-04
                                 /. S
                                          7110.4
                  /1.2024E-05
                                 /, CAZ
                                          /1116.45/.
            RHOZ
                                 /, GZENG /32.1741/
                  10.076474
   CONVERT GEOMETRIC ALTITUDE TO GEOPOTENTIAL ALTITUDE
      HFT = (REFT59/(REFT59+ZFT))*ZFT
   CONVERT HET AND ZET TO KILOMETERS
      Z = FITOKM*ZFT
      H = FTTOKM*HFT
      K = 1
      THZ = THB(2)
      IF (H.LT.-5.0.OR.Z.GT.90.0) GO TC 16
      00 10 H=1,10
      IF {H~HB(M)) 11,12,10
   10 CONTINUE
      GO TO 16
   11 M = M-1
   12 OELH = H-HB(F)
      IF (ALM(M) .EQ.Q.Q)
                          GO TO 13
      THK = THB(F)+ALM(M) +DELH
   GRACTENT IS NON ZERO, PAGE 10, EQUATION 1.2.10-(3)
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DELTA = DELTAB(H)+((THB(H)/THK)++(GZ+AHZ/(RSTAR+ALH(H))))
      GO TO 14
   13 THK = THE(M)
   GRADIENT IS ZERO, PAGE 10, EQUATION 1.2.10-(4)
      DELTA = DELTAB(H) *EXP(-GZ*AHZ*DELH/(RSTAR*THB(H)))
   14 THETA = THK/THZ
      SIGNA = DELTA/THETA
      ALPHA = SQRT (THETA++3)+ (CTHZ+S)/(THK+S))
   CONVERSION TO ENGLISH UNITS
      TH = 1.87THK
      RHO = RHOZ+SIGNA/GZENG
      CA = CAZ*SORT(THETA)
      AMU = AMUZ +ALPHA/GZENG
C
      CALL OVERFL(J)
      J= 2
        GO TO (15,17), J
   15 K = K+2
      GO TO 17
   16 K = 2
   17 RETURN
      END
```

とのようなできない。これは、それでは、などのではなっているというないできない。

```
SUBROUTINE COFAN
      COMMON /
                   ALL/
             , IDES , JDES , KDES
                                    , HODE , INIT
                                                      ,IDUMP ,IAHTP ,
     2 IG ASHX, IDBURN, IAFTBN, IDCD
                                     ,IMCD ,IDSHGC,IMSHOC,NOZFLT.
     3 IT RYS, LOOPER, NOWAP, NUMMAP, MAPEDG. TOLALL.ERR(9)
      COMMON/DESIGN/
     1PCNFGU ,PCNIGU ,FCNCGU ,T4GU
                                          , BUHD1
                                                    DELFG.
                                                             , DELFN
                                                                      ,DELSFC ,
                                                             ,ETAFCF
     2 ZF DS
              ,PCNFDS ,PRFDS
                                 , ETAFOS , WAFDS
                                                    .PRFCF
                                                                      . WAFCF
                                                    ,PRICF
     3 21 DS
              ,PCKICS ,FRIOS
                                 , ETAIDS , WAIDS
                                                             ,ETAICF
                                                                     , WAICF
                                                    ,PRCCF
     4 ZC DS
              , PCNCDS , PRCDS
                                 ,EYACOS ,WACOS
                                                             , ETACCF , WACCF
                       ,OTCODS ,ETABOS , WA3COS ,OPCODS ,OTCGCF ,ETABGF
     5 T4 OS
              , WF8DS
     6TFHPDS , CNHPDS , ETHPDS , TFHPCF , CNHPCF , ETHPCF , DHHFCF , T2DS
     7 TF IPOS , CNIPCS , ETIPOS , TFIPCF , CNIPCF , ETIPCF , OHIPCF , T210S
     8 TFLPOS , CNLPDS , ETLPOS , TFLPCF , CNLPCF
                                                    ,ETLPCF , DHLPCF
                                                                      ,122DS
              , WF CDS
                        ,OTDUDS ,ETADOS , HA23OS
                                                    ,OPDUDS ,DTOUCF
                                                                      , ETADCF
     9 T2 4 D S
              , HF ADS
                                          , MG6CDS , OPAFOS , STAFCF
     ATT DS
                        , DTAFOS , ETAADS
                                                                     .ETAACF
              , A25
                                 , 47
                                                                      , A29
                                                    ,A9
                                                             , A28
     B A55
                        , A6
                                          , 46
     C PS 55
              , AM 55
                        ,CVDNOZ ,CVMNOZ ,AESAV
                                                    ,A9SAV
                                                             VAZESAV , AZESAV
      COMMON/ FRONT/
              , F1
                                                    ,P2
                        , #1
                                 21 و
     1 T1
                                          ,T2
                                                             , H2
                                                                      , 52
                                 , 521
     2 T2 1
              .P21
                                          ,T22
                                                    ,P22
                                                             .H22
                                                                      .$22
                        ,H21
              , P3
                        , H3
     3 T3
                                 , 53
                                          ,T4
                                                    ,P4
                                                             ,H4
                                                                      ,54
              ,F45
                        , H45
                                 ,545
                                          ,T5
                                                    , P5
                                                                      , 55
     4 T4 5
                                                             , H5
              , F55
                                          ,BLF
                                                             , BLC
                                                                      , BLDU
     5155
                                 ,355
                        , H55
                                                    ,BLI
              , PRF
                        , ETAF
                                 , HAFC
                                          . HAF
                                                    ,BLDUI
                                                             ,BLDUC
     6 CNF
                                                                      , BLOB
              ,PRI
                        ,ETAI
                                 , HAIC
                                          , HAI
                                                    , BLOBI
     7 CN I
                                                             .BLOBC
                                                                      . WA3
                                 , WACC
                                                             , RPCSH
                                                                      , HG4
     8 CN C
              FRC
                        .ETAC
                                          * H AC
                                                    ,ETAB
     9 CN HP
              , ET ATHP
                        , DHT CHP
                                 , DHTC
                                          , BLHP
                                                    ,BLHPI
                                                             , BLHPC
                                                                       ,FAR4
     A CN IP
              , ET AT IP
                        , DHT CIP
                                 . DHTI
                                          , BLIP
                                                    ,BLIPI
                                                             ,BLIPA
                                                                       . DUKF
                        , DHTCLP
              , ETATLP
                                 , DHTF
                                                    ,BLLPI
                                                             ,BLLPC
     BCNLP
                                          , BLLP
                                                                      ,CS
                        , NG5
                                 ,FAR5
                                                             , HPEXT
                                                                       , AM
     C KG 45
              ,FAR45
                                           , H G 55
                                                    FAR55
                        ,ZF
                                 , PCNF
                                                                      , PCNC
     DALTP
                                                    ,PCNI
              , ET AR
                                          , 21
                                                             , ZC
                        , TFF IP
              , TFFHP
                                 , TFFLP
                                          ,PCBLF
                                                    ,PCBLI
                                                             , PCBLC
                                                                      ,PCBLDUI,
     FPC8LDUC, PC8LG8I, PC8L9BC, PC8LHPI, PC8LHPC, PC8LIPI, PC8LIPC, PG8LLFI,
     GFCBLLPC
      COMMON / FAN/CNX(15),PRX(15,15),WACX(15,15),ETAX(15,15),
     1 NC N, NPT (15)
      DIMENSION WLH(2)
      DATA ANDRO, HER/GH COFAN, GH (LO), GH (HI) /
      HORD = AHORD
      THETA=SQRT (T2/518.668)
      IF (IDES, NE.1) GO TO 10
      THET AU=THE TA
      CHF=PCNF*THETAO/(100.*THETA)
      IF (ZF.Lf.0.) ZF*0.
      IF (ZF.GY.1.) ZF=1.
      CNFS=CNF
      CALL SEARCH(2F, CNF, PRF, WAFG, ETAF,
     1CHX(1),NCN,PRX(1,1),HACX(1,1),EYAX(1,1),NPT(1),15,15,1G()
       IF (IGNF-CNFS).GT.O, 0805*CNF) HAPECG=1
       If (IGC.EC.1.0%, IGO.EC.2) WRITE(8,1000) CNFS, WLH(IGO)
      Forhatilighof & # CNF OFF Map. Flo. 4, 2xa6, 11H* # #$$$$$$)
1056
      KAF=HAFC+F2/THETA
       IF (IDES. NE.1) GO TO 1
       PRESE = (PRECS+1.)/(PRE+1.)
```

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```
ETAFCF=LTAFUS/ETAF
       HAFCF=WAFDS/WAF
       WRITE(6,100) PRFCF, ETAFCF, WAFCF, T2CS
       FORMAT(11HOFAN DESIGN, 13x8H PRFCF=, E15.8, 8H ETAFCF=, E15.8,
100
           MAFCF=,E15.8,8H
                               T2DS=.E15.8)
      PRF=PRFCF* (PRF-1.)+1.
      ET AF=ETAFOF+ETAF
       WAF=WAFCF+ WAF
      CALL THCOMP(FRF, ETAF, T2, H2, S2, P2, T21, H21, S21, F21)
       IF (PCBLF.GT.O.) BLF=PCBLF+WAF
       IF (JDES.EQ.1) GO TO 7
       JDES=1
       IF (INST. EQ. 1) GO TO 6
       IF (IDES.EQ.1) GO TO 4
       IF (NODE.NE.2) GG TO 2
      T4 & GUESS (3, Y1, Y2, PCNF, PCNFDS, NF8, NFBDS, Y7, Y8, T4DS)
      PCNI=GUESS (8.T4.Y4DS,Y3.Y4,Y5,Y6,T21,T21DS.PCNIDS)
       PCNG=GUESS (4, Y1, Y2, PCNF, PCNFDS, NF8, NFBDS, Y7, Y8, PCNCDS)
       GO TO 5
       IF (MODE.EQ.1) GO 30 3
2
       IF (MODE, EQ. 0) GC TO 20
       T4 = GUESS (7, Y1, Y2; PCNF, PCNFOS, Y5, Y6, T2, T2DS, T4DS)
20
      PC NC = GUESS (5, T4, T4DS, Y3, Y4, Y5, Y6, T21, T21DS, PCNCDS)
      PCNI=GUESS (9, Y1, Y2, PCNC, PCNCDS, Y5, Y6, T21, T21DS, PCNIDS)
       GO TO 5
       T4=GUESS (6, Y1, Y2, PCNC, PCNCDS, Y5, Y6, T21, T21DS, T4DS)
       FCNI=GUESS (8, T4, T4DS, Y3, Y4, Y5, Y6, T21, T21DS, PCNIDS)
       GO TC 5
      PC NC *PCNCDS
      PCNI=PCNIGS
       14=T4CS
      WF B= MF8DS
      T2iúS=T21
5
       ZC =ZCDS
      ZI=ZICS
      PENIGU=PCNI
      PC NC GU=PCN C
      T4 GU=T4
       INIT=0
6
       IF (MODE.NE.3) GO TO B
       IF (ABS(GNF-CNFS).LE.G.DO1+CNFS) GO TO 9
       HR TTE (8, 2) 06) CNFS, CNF
       FORMAT(10HOGNE WAS= ,E15.8,11H
2000
                                           AND NOW= ,E15.8,
     124H CHECK PONF INPUTS3888)
       CALL ERRCR
       PC NF = 100 . THETA + CNF/THETAD
       CALL COINTC
       RETURN
```

EN D

```
SUBROUTINE CGINTC
     CO MMON/
                 ALL!
            , ICES
                     ,JDES
                            , KOES
                                     HODE
    3 HG RO
                                             , INIT , IDUMP , IANTP ,
    2 IG ASMX, TOBURN, IAFTSN, IDCD . IDSHGC. IMSHGC. NOZFLT.
    3 IT RYS, LOOPER, NOMAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
      COMMON/DESIGN/
    190 NFGU , PC NIGU , PCNCEU , TAGU
                                          , BLHD1
                                                                      ,DELSFC .
                                                   DELFG
                                                             , UEI.FN
              ,PCHFOS ,PRFOS
    2 ZF D3
                                ETAFUS . HAFDS
                                                   .PRFCF
                                                             .ETAFOF ,WAFOF
    3 ZI DS
              , PCNICS , FRIDS
                                         , WAIDS
                                                   ,PRICF
                                , ETAIDS
                                                             ETAICE SKAICE
                                , ETACOS
                                         , WACDS
                                                   PRCCF
                                                             , ETACCF , WACCF
    4 2C DS
              ,PCNODS ,PRODS
                       DTCOOS , ETABUS
                                         , WA3CDS
    574 DS
              . WE EDS
                                                   , OPGODS , DTCOCF , ETABLE
    6TFHPDS , CNHPOS , ETHPOS , TFHPCF
                                         , CNHPCF
                                                   ,ETHPOF ,OHKPOF ,TEUS
    7 TF IPOS , CNIPOS SEYIPOS , TFIPOF , GNIPOF
                                                  ,CTIPCF ,DHIPCF ,T2105
    8 TFLPDS , CNLPDS , ETLPDS , TFLPCF , CNLPCF
                                                  ,ETLPCF ,DHLPCF ,T22DS
    912405
             , HF DDS
                       , OTOUDS , ETADOS , WAZZOS , OPOUDS , OTOUCF , ETADOF
    ATT OS
              , WF ADS
                       , DTAFOS , ETAADS , NGGCDS , DPAFDS , DTAFOF , ETAACH
              , A25
    B 455
                       , A6
                                , A?
                                          , A 8
                                                   ,A9
                                                             ,A28
                                                                      , A29
    CPS 55
              , AM 5%
                       ,CVDNOZ ,CVMNOZ ,A8SAV
                                                   ,A9SAV
                                                             ,A28SAV ,A29SAV
     COMMON/ FRONT/
                                                   ,P2
    1 T1
             ,P1
                       ,H1
                                ,51
                                          , T2
                                                                      , $2
                                                             . HZ
    2121
              , 621
                       ,H21
                                          ,T22
                                                   ,P22
                                , $21
                                                             ,H22
                                                                      ,522
    3 T3
              , P3
                                          ,T4
                                                             , H4
                                                                      ,54
                       , H3
                                , S3
                                                   , P4
             , P45
                                                   , P5
                       ,H45
                                ,545
                                          , T5
                                                             , H5
    4T45
                                                                      ,55
                                , 555
    5 T5 5
             , 055
                                          , alf
                       , H55
                                                   ,BLI
                                                             , BLC
                                                                      , BLOU
    6 CN F
              , PRF
                       SETAF
                                , HAFC
                                          , WAF
                                                   BLDUI
                                                             , BLDUC
                                                                      , BLOB
    7 CN I
              ,PRI
                       , ETAI
                                , HAIC
                                                             ,BLOBC
                                          , HAI
                                                   ,BLOBI
                                                                      , WA3
                       ,ETAC
    8 CN C
              . FRC
                                , WAGC
                                          , HAC
                                                   ,ETAB
                                                             , DPCCH
                                                                      , WG4
    9 CN HP
             .ET ATHP
                       , DHT CHP
                                , DHTC
                                          , BLHP
                                                   ,BLHPI
                                                             ,BLHFC
                                                                      ,FAR4
    ACNIP
             , ETATIP
                       , OHT CIF
                                , BHTI
                                          ,BLIP
                                                             , BL IPC
                                                   ,BLIPI
                                                                      , DUMF
    BCNLP
              , ETATLP , OHTCLP , OHTF
                                          , ellp
                                                   BLLPI
                                                             , BLLPC
                                                                      • CS
                                          , NG55
                                                             , HPEXT
    C NG 45
                       s NG5
                                , FARS
                                                                      , AM
             , FA F45
                                                   FAR55
                       ,ZF
                                                                      , PCNC
                                , PCNF
    DALTP
                                          oZI
             , ET AR
                                                   ,PCNI
                                                             , ZC
                       ,TEFIP
                                          ,PCBLF
             ,TFFHP
                                , TEFLP
                                                   ,PCBLI
                                                             ,PCBLC
                                                                      ,PCBLGJI,
    FPU3LDUC, PCBLCBI, PCBLOBC, PCBLHPZ, PCBLHPC, PCBLIPI, PCBLIPC, PCBLLPT,
    GPC BLLFQ
     COMMON/IPHF/hA22
     COMMON
                INT/CNX(15),PRX(15,15),WACX(15,15),ETAX(15,15),
    1 NCN, NPT (15)
     DIMENSION WLH(2)
     DATA AWORD, WLH/6HCOINTC, 6H (LO), 6H (HI) /
     40 RU = AHORO
     THETA=SQRT (T21/518.668)
     IF (IDES.NE.1) GO TO 15
     THET AC=THE TA
     CN 1=PCNI*THETAD/(100.*THETA)
     IF (ZI.LT.O.) ZI=O.
     IF (ZI.67.1.) ZI=1.
     おけIS=CNI
     GALL SEARCHIZE, CNI, PRI, WAIC, ETAE,
    1 CN Y(1), NCN, PRX(1,1), WACX (1,1), ETAX(1,1), NPT (1), 15, 15, IGO)
     IF ((GhI-Chis).Gt..O005+Chi) MAPEDG=1
     IF (IGO.EQ. 1. OR. IGO. EQ. 2) WRITE (8, 1990) CNIS, WLH (IGO)
1000 FORMAT(19NO* * * CNI OFF MAP, F10.4, 2XA6, 11H* * *$$$$$)
     WAI = WAIC *P 21/THETA
     IF (IDES.NE.1) GC TO '
```

A PROPERTY OF THE PROPERTY OF

PRICF=(PRIDS-1.)/(PRI-1.) ET AICF=ETAIDS/ETAI NAICF=HAIDS/HAI HRITE (6, 100) PRICE, ETAICE, WAIGE, T210S 100 FORMAT (23HOI.P. COMPRESSOR DESIGN, 1X8H PRICF=, E15.8, 8H ETAICS 1E15.8,8H WAICF=,E15.8,8H T21DS=,E15.8) PRJ=PRICF+(PRI-1.)+1. ET AI = ET A ICF + ET A I WAI=WAICF+WAI CALL THCOMP(PRI, ETAI, 721, H21, S21, P21, T22, H22, S22, P22) IF (IDES.EQ.1) T2205=T22 IF (PCBLI.GT.O) BLI=PCBLI=WAI HA22=HAI-BLI BL DUZ=PCBL CUI\*BLI BLHPI\*PCBLHPI\*BLI BL IPI=PC8L IPI\*BLI BL OBI=PCBL CBI\*BLI PCNI=100.+TKETA+CNI/THETAD CALL COCOMP RETURN EN D

```
SUBROUTINE COCOMP
                   ALL/
      COMMON /
                     JOES
                                     , MODE
             , IDES
                             ,KDES
                                             , INIT , IDUMP , IAMTP ,
     2 IG ASMX.IDBURN.IAFTBN.IDCD
                                     , INCD , IDSHOC, INSHOC, HOZFLT.
     3 IT RYS, LOOPER, MOMAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
      CO MMON/DES ZGN/
     1 FC NFGU , PC NIGU , PCNCGU , T4GU
                                                    ,DELFG
                                                              , DELFN
                                           ,DUMD1
                                                                        , DELSFC
                                 , ETAFDS , WAFDS
                                                    ,PRFCF
                                                              , ETAFCF
     2 ZF DS
              , PCNFOS , PRFDS
                                                                        , NAFCF
                                                              , ETAICF , NATOF
     3 ZI 0S
              , PC NIOS , FRIDS
                                 , ETAIDS , HAIDS
                                                     ,PRICF
                                           , WACDS
     4 ZC DS
              , PCNCCS , PRCDS
                                 , ETACOS
                                                     ,PRCCF
                                                              , ETACCF , WACUF
              , WF BDS
                                          .NAJCOS .DPCODS .DTCOCF .ETABCF
     5 T4 D5
                        ,CTCCDS ,ETABOS
     6 TEHPOS , CNHPOS , ETHPOS , TEHPOF , CNHPOF , ETHPOF , DHHFOF , T20S
     7TFIPOS, CNIPOS, ETIPOS, TFIPCF
                                           , CHIPCF , ETIPCF , OHIPCF , T2108
                                                              , DHLPCF , T2205
                                           ,CNLPCF
     8TFLPOS, CNLPOS, ETLPOS, TFLPCF
                                                    ,ETLPCF
                                                                       , ETADOF
                                           , HAZZOS
                                                     , OPDUOS , OTDUCF
     9 TZ 40 S
               , WF GDS
                        DTDUDS , ETADOS
               , NF ADS
                                                    , OPAFOS , DTAFCF , ETAACF
     4 17 05
                        , OTAFOS , ETAADS
                                           , WG6CDS
                                                     ,A9
                        , A6
                                                                        , A29
     B 455
                                  , A7
                                           , 48
                                                              ,A28
               , 425
     CFS 55
               , AM 55
                        ,CYDNOZ ,CVHNOZ ,A8SAV
                                                              VAZESAY , AZESAV
                                                     ,A9SAV
      COMMON/ FRONT/
               ,P1
     171
                                           ,12
                                                     ,P2
                        , H1
                                  ,51
                                                              , H2
                                                                        , S2
     2121
                                  ,521
                                           , 122
                                                     ,P22
               , F21
                        ,H21
                                                              ,H22
                                                                        ,522
     3 T3
               , F3
                        . H3
                                  <sub>2</sub> S3
                                           , 74
                                                     ,P4
                                                              . 44
                                                                        .54
               , P45
                        , H45
                                                     ,P5
     4145
                                  .S45
                                           ,T5
                                                              . H5
                                                                        , S5
               , P55
                        , H55
                                  ,$55
                                                     ,BLI
                                                              , BL C
     5155
                                           , OLF
                                                                        , BLOU
                                  , WAFC
                                                              , eL DUC
               , FRF
                        , ETAF
                                           , HAF
                                                     'aroni
     6 CN F
                                                                        ,BLOB
                                                              , BLOBC
                                                                        , WA3
     1 CN I
               , PRI
                        ,ETAI
                                  , HAIC
                                           , WAI
                                                     'Brosi
               , PRC
                                           , HAC
                                                              , DPCOH
                        PETAC
                                  , HACC
                                                     ,ETAB
     8 CNC
                                                                        . HG4
     9 CN HP
               . ET ATHP
                        , DHTCHP , DHTC
                                           , BLHP
                                                              , BL HPC
                                                     ,BLHPI
                                                                        ,FAR4
     ACNIP
               , ETATIP
                        , OHTCIP
                                           ,BLIP
                                                              , BLIFC
                                                                        , DUHF
                                 * DHII
                                                     HLIPI
                                           , BLLP
     3 CNLP
               , ETATLP
                        . DHT CLP
                                  , OHTF
                                                     ,BLLPI
                                                              , BLLPC
                                                                        , CS
               oFAR45
                        , NG5
                                  ,FAR5
                                           , WG55
                                                     ,FAR55
                                                              , HPEXT
     C NG 45
                                                                        , AM
                                                                        , PCNC
     GALTP
                        , ZF
                                  , PCNF
                                           ,ZI
                                                     ,PCNI
               , ET AR
                                                              , ZC
                                           ,PCBLF
                                                              , PCBLC
                                                                        , PCBLOU .
               , TFFHF
                        , TFF IP
                                  , TFFLP
                                                     ,PCBLI
     ENFB
     FPG BL OUC, PC CL CBI, FCBLOBC, PCBLHPI, PCBLHPC, PCBLIPI, PCBLIPC, PCBLLPI
     GPC BL L FC
      COMMON/IPHP/WA22
      COMMON / COMP/CMX(15),PRX(15,15),WACX(15,15),ETAX(15,15),
     1 NC N, NFT (15)
      DIMENSION WLH(2)
       CATA AWORD , NEH/6HCOCOMP, 6H (LO) , 6H (HI) /
      MORO = AWORD
       THETA=SURT (T22/518.688)
       IF (IDES.NE.1) GC TO 10
       THETAD=THE TA
       CNC=PCNC+THETAD/(100.+THETA)
       1F(ZC.LT.0.) ZC=0.
       IF (ZC.GT.1.) ZC=1.
       CNCS = CNC
       CALL SEARCH(ZC, CNC, PRC, WACC, ETAC,
     1CNX(1),NCN.PRX(1,1),WACX(1,1),ETAX(1,1),NPT(1),15,15,IGO)
       IF ! MODE. EQ.1) GO TO 1
       IF ((CNC+CNCS).GT.O.0005*CNC) MAPECG=1
       IF(IGO.EQ.1.CR.IGO.EQ.2) WRITE(8,1000) CNCS.WLH(IGO)
1000
       FORHAT(19H0+ * + CNC OFF MAP, F10.4, 2XA6, 11H+ + +$$$$$$)
       HAC=WACC+P22/THETA
```

```
IF (IDES. NE.1) GC TO 2
      HACDS=HA22
      PRGCF={PRCDS-1.}/(PRC-1.)
      ET ACCF=ETACDS/ETAC
      WACCF=WACDS/WAC
      WRITE (6, 100) PRCCF, ETACCF, WACCF, T22DS
 100
      FORMAT(23HOH.P. COMPRESSOR DESIGN,1X8H PROCF=,E15.8,8H ETACCF=,
     1615.6,8H WACCF=,E15.8,8H T22DS=,E15.8}
ã
      FRG#PRCCF# (PRC-1.)+1.
      ET AC = ETACCF*ETAC
      HAC=HACCF+HAC
      GALL THOOMP (PRC, ETAC, T22, H22, S22, F22, T3, H3, S3, P3)
      IF (PCBLC.GT.D.) BLC=PCBLC+WAC
      WA 3= WAC-BL C
      BL DUG = PCBL EUC + BLC
      BL HPC=PC8L HPC*BLC
      SLIPC=PCSLIPC+BLC
      BLLPG=PCBLLFC*BLC
      BL (BC=PCBLOBC+BLC
      " GU= BLDUI +BLDUC
      & HP=8LHPI+BLHPC
      BL IP=BLIPI +BLIPC
      BLLP=BLLPI+BLLPC
      FLOB=BLOSI+BLCBC
      IF (MODE-NE.1) GO TO 3
      IF (ABS(CNC-CNCS).LE.O.GO1+CNCS) GO TO 4
      HRITE(6,2000)CNCS,CNC
      FORMAT (10HOCNC WAS= yE15.8,11H
2000
                                         AND NON= ,E15.8,
     124H GHECK PCNC INPUTSSSSSS)
      CALL ERROR
 3
      PCNC=100. + THETA+CNC/THETAD
      ERR(7)=(WAC-WA22)/HAC
      CALL COCOMB
      RETURN
      END
```

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```
SUBROUTINE CCCOME
 NOMMCD
              ALL/
               ,JDES
                        ,KDES
                                 , MODE
1 HO RO
        ,IOES
                                                  , IDUMP , IAPTP ,
                                        , INIT
2 IGASMX, ICBURN, IAFTBN, IDCD
                                 , IMCC
                                         , IOSHOC, INSHOC, NOZFLT,
3 IT RYS, LCOPER, NONAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
 COMMON/DESIGN/
1 PCNFGU , PCNIGU , PCNCGU , T4GU
                                      , DLHD1
                                                ,DELFG
                                                         , DELFN
                                                                   , DELSFC
2 ZF DS
         ,PCNFOS ,PRFDS
                            , ETAFOS , WAFOS
                                                .PRFCF
                                                         , ETAFCF
                                                                  , WAFCF
3 2I DS
                                      , WAIDS
         ,PCNICS ,PRIDS
                            , ETAIDS
                                                ,PRICF
                                                         , ETAICF
                                                                  , WAICF
                            , ETACOS
                                                ,PRCCF
4 ZC DS
         , PCNCCS , PRCDS
                                      , WACDS
                                                         ,ETACCF
                                                                  , WACCF
5 T4 DS
         , WF BOS
                   , GTC ODS , ETABOS , WA3CDS
                                                         ,DTCOCF ,ETABCF
                                               ,DPCODS
6TFHPDS , CNHPDS , ETHPDS , TFHPCF , CNHPCF
                                               ,ETHPCF
                                                         ,DHHPCF ,T20S
7 TF IPOS , CN IPCS , ET IPOS , TF IPCF , CN IPCF
                                               ,ETIPCF ,DHIPCF ,T210S
BIFLPOS , CNLPCS , ETLPOS , TFLPCF , CNLPCF
                                               ,ETLPCF , DHLPCF
                                                                  ,T22DS
         , WF ODS
                   ,CTDUDS ,ETADDS ,HA23DS
9 T2 4 D S
                                               ,OPDUDS ,DTDUCF
                                                                  ,ETADCF
AT7 DS
         , WF ADS
                   ,DTAFDS
                            ,ETAADS , WG6CDS
                                               , DPAFDS
                                                        ,DTAFCF ,ETAACF
B 455
         . 425
                                      9A,
                                                                   ,A29
                   , A6
                            . A7
                                               ,A9
                                                         ,A28
         , AM 55
                   , GVDNOZ
CPS 55
                           ,CVHNOZ ,AESAV
                                               ,A9SAV
                                                         ,A28SAV ,A29SAV
 COMMON/ FRONT/
1 T1
         , P1
                            , S1
                                                                   ,52
                   ,H1
                                      , T 2
                                                ,P2
                                                         , H2
         ,P21
2721
                   ,H21
                            . S21
                                      ,T22
                                                ,P22
                                                         , H22
                                                                   ,522
         , P3
                                      ,T4
                                               ,P4
                   ,H3
                            , $3
                                                         , H4
3 13
                                                                   ,54
         , P45
4 T4 5
                   , H45
                            , 545
                                      , T5
                                                ,P5
                                                         , H5
                                                                   , $5
5 T5 5
         , P55
                   , F55
                                      ,BLF
                                                                   ,BLJU
                            , S55
                                                ,BLI
                                                         ,BLC
                                      , WAF
                                                                   ,BL08
                   , ETAF
                            , WAFC
                                                         , BLDUC
6 CNF
         , PRF
                                                ,BLDUI
         , PRI
                                      , WAI
7 CN I
                   ,ETAI
                            , WAIC
                                                ,BLOBI
                                                         ,BLOBC
                                                                   , WA3
         , PRC
8 CNC
                            , HACC
                   , ETAC
                                      , HAC
                                                ,ETAB
                                                         , DPCOM
                                                                   , WG4
9 CN HP
         , ET ATHP
                   , DHT CHP
                                      ,BLHP
                            , DHTC
                                                ,BLHPI
                                                         , BLHPC
                                                                   FAR4
ACNIP
                            , DHTI
                                      , BLIP
                                                ,BLIPI
                                                         ,BLIFC
         , ETATIP
                   ,DHTCIP
                                                                   . DUMF
BCNLP
         , ET ATLP
                   , DHT CLP
                            , DHTF
                                      ,BLLP
                                                ,BLLPI
                                                         , BLLPC
                                                                   ,CS
C NG 45
         ,FAR45
                   , WG5
                            ,FAR5
                                      , WG55
                                                ,FAR55
                                                         , HPEXT
                                                                   , AH
DALTP
                   ,ZF
                            , PCNF
                                                                   , PCNC
         , ETAR
                                      ,21
                                                ,PCNI
                                                         , ZC
EMFB
         , TFFHF
                   ,TFFIP
                            , TFFLP
                                                         , PCBLC
                                                                   ,PCBL DUI,
                                      ,PCBLF
                                                ,PCBLI
FPCBLDUC,PCBLCBI,FCBLGBC,FCBLHPI,PCBLHPC,PCBLIFI,PCBLIPC,PCBLLPI,
G PC BLL PC
 COMMON / COME/PSI(15), DELT(15,15), ETA(15,15), NPS, NPT(15)
 CIMENSION G(9), CUMBO(15,15)
 DATA AWORD/6HCOCOMB/
 WORD = AWORD
 Q(2) = 0.
 Q(3) = 0.
 P3PSI=14.696*P3
 HA3C=HA3+SGRT(T3)/P3PSI
 IF (IDES.EQ.1) WA3CDS=WA3C
 OPCOM=OPCOCS+(WA3C/WA3CDS)
 IF (OPCOM.GT.1.) OPCOM=1.
 P4 = P3 * (1 .- DFCOM)
 IF (T4.GT.3599.) T4=3999.
 IF (T4.GE.1000.) GO TO 2
 T4=1000.
 IF (MODE.EQ.1) MAPEDG=1
 CT CO = T4 - T3
 IF (IDES.NE.1) GC TO 3
 DT COCF=DTCCDS/DTCO
 GT CO = CTCOCF + CTCC
```

1

2

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F3PSIN=P3PSI
      CALL SEARCH(-1., P3PSIN, DTGO, ETAB, CUMMY,
     1PS I(1), NPS, DELT(1,1), ETA(1,1), DUNEO(1,1), NPT(1), 15,15, IGO)
      IF(IGO.EQ.7) CALL ERROR
      IF (IDES. NE.1) GO TO 5
      ET ABCF=ETABDS/ETAB
      ET AB = ET ABC F * ET AB
5
      HV={(((((-.4594317E-19+T4)-.2034116E-15)+T4+.2783643E-11)+T4
     1+.2051501E-07)*T4-.2453116E-03)*T4-.9433296E-01)*T4+.1845537E+05
      CALL THERMO(P4, HA, T4, XX1, XX2, 0, 0.0, 0)
      FAR4= (HA-H3) / (HV+ETAB)
      IF (FAR4.LT.O.) FAR4=0.
      HFBX=FAR4+ NA3
      IF (MODE.NE.2) GO TO 8
      ERRH= (WF8-WF8X) / WF8
      DIR=SORT (WFB/WFBX)
      CALL AFQUIR(G(1),T4,ERRH,0.,20.,0.0001,DIR,T4T,IGO)
      GO TO (6,9,7),IGO
      T4=T4T
6
      GO TO 1
7
      CALL ERROR
      hF8=WFBX
      CALL THERMO(F4, H4, T4, S4, XX2, 1, FAR4, 0)
      HG 4=HFB+HA 3
      IF (IDES.EQ.1) WRITE (6,100) WA3CDS, ETABCF, DTCOCF
100
      FORMAT(17HOCOMBUSTOR DESIGN,7X8H WA3CDS=,E15.8,8H ETABCF=,E15.8,
     18H DTCOCF=,E15.8)
      CALL COMPTE
      RETURN
      END
```

TENNE S

```
SUBROUTINE COMPTB
       COMMON /
                    ALL/
                             ,KDES
                                      , MODE
                                              , INIT , IDUPP , IAHTP ,
             ,IDES ,JDES
     1 WO RD
                                              .IDSHOC, IMSHOC, NOZFLT,
     2 IG ASMX, IDBURN, IAFTBN, IOCD
                                     .IMCD
     3 IT RYS, LOOPER, NOPAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
       COMMON/DES IGN/
                                           ,OUMD1
                                                    ,DELFG
     1PC NFGU , PC NIGU , PC NCGU , T4GU
                                                             , DELFN
                                                                       ,DELSFC ,
                                                    ,PRFCF
              ,PCNFCS ,PRFDS ,ETAFDS ,WAFDS
                                                             ,ETAFCF , WAFCF
     3 ZI OS
               ,PCNICS ,PRIDS
                                 , ETAIDS , WAIDS
                                                    ,PRICF
                                                             , ETAICF , WAICF
     4ZCOS
               , PCNCOS , PRCOS
                                 , ETACOS , WACOS
                                                    ,PRCCF
                                                              ,ETACCF
                                                                       , WACCF
                                          , HA3CDS
                                                                      ,ETABCF
     5 T4 DS
               , WF EDS
                        ,OTCODS ,ETABOS
                                                    ,DPCODS ,DTCOCF
                                          , CNHPCF
     6 TFHPOS , CN+POS , ETHPOS , TFHPCF
                                                    ,ETHPCF ,DHHPCF ,T2DS
     7 TFIPOS, CNIPOS, ETIPOS, TFIPOF, CNIPCF
                                                    ,ETIPCF ,DHIPCF ,T210S
     8 TFLPOS , CNLPCS , ETLPDS , TFLPCF , CNLPCF
                                                    ,ETLPCF , DHLFCF , T22DS
     9 T2 4DS
               , WF COS
                        ,CTDUDS ,ETADDS , WA230S , OPOUDS , OTOUCF , ETADCF
                        ,DTAFDS ,ETAADS ,NG6CDS ,DPAFOS ,DTAFCF ,ETAACF
     AT7 DS
               , HF ADS
     B A5 5
               , A25
                        , 46
                                 , A7
                                           , A8
                                                    ,A9
                                                              ,A28
                                                                       ,A29
     CPS 55
               , AH 55
                        ,CVDNOZ ,CVMNOZ ,AESAV
                                                    ,A9SAV
                                                              ,A28SAV ,A29SAV
       COMMON/ FRONT/
     1 T1
               , P1
                        , H1
                                 , $1
                                           ,T2
                                                    ,P2
                                                              ,H2
                                                                       ,S2
     2121
               , P2 1
                        ,H21
                                 ,S21
                                           ,T22
                                                    ,P22
                                                              ,H22
                                                                       ,522
                                           ,T4
                                                    ,P4
                                                                       ,54
     313
               , P3
                        , H3
                                 , $3
                                                              . H4
                                 ,545
                                           ,T5
                                                    ,P5
     4 14 5
               , P45
                        . H45
                                                              . H5
                                                                       , S5
                                 ,S55
                                           , BLF
     5155
               , P55
                        , H55
                                                    ,BLI
                                                              ,BLC
                                                                       , BLOU
     6 CNF
               , PRF
                        ,ETAF
                                 , HAFC
                                           , WAF
                                                    ,BLDUI
                                                             , BLDUC
                                                                       ,BLOB
                                 , WAIC
                                                    ,BLOBI
                                                                       , HA3
     7 CN I
               , PRI
                        ,ETAI
                                           , HAI
                                                              , BL OBC
                                 , WACC
               , PRC
                        , ETAC
                                           , HAC
                                                    ,ETAB
                                                                       , WG4
     8 CN C
                                                              , DPCOM
              , ET ATHP
     9 CN HP
                        ,DHTCHP ,DHTC
                                           , BLHP
                                                    ,BLHPI
                                                              .BLHPC
                                                                       ,FAR4
     A CN IP
              , ETATIP , OHTCIP , DHTI
                                           , BLIP
                                                    ,BLIPI
                                                              ,BLIPC
                                                                       , DUMF
     BCNLP
               ,ETATLP ,DHTCLP , DHTF
                                           ,BLLP
                                                    ,BLLPI
                                                                       ,CS
                                                             BLLPC
                        , HG5
                                 ,FAR5
                                           , HG55
                                                                       , AM
     C WG 45
               ,FAR45
                                                              , HPEXT
                                                    ,FAR55
     DALTP
                        ,ZF
                                                                       , PCNC
                                 , PCNF
               , ET AR
                                           ,21
                                                    ,PCNI
                                                             , ZC
                        , TFF IP
                                                    ,PCBLI
     E WF B
               , TF FHP
                                 , TFFLP
                                                                       ,PCBL GUI,
                                           ,PC9LF
                                                             ,PCBLC
     FPC BL DUC, PC BL GBI, PCBL GBC, PCBL HFI, PCBL HPC, PCBL IFI, PCBL IPC, PCBL LPI,
     G PC BLLFC
      COMMON /HTURB/TFFX(15), CNX(15,15), DHTCX(15,15), ETATX(15,15),
     1 NT FFS, NPTT FF (15)
       DATA AWORD, WLO, WHI/6HCOHPTB, 6H (LC), 6H (HI) /
      WO RD = AWO RD
      IF (IOES.EQ.0) GO TO 1
      CN HPCF=CNH FDS+SQRT (T4) /PCNC
      CNHP=CNHPCF*PCNC/SQRT(T4)
      CN HPS = CN HP
      TF FHPS=T FF HP
       CALL SEARCH (-1., TFFHP, CNHP, DHTCHP, ETATHP,
     1 TF FX (1), NT FFS, CNX(1,1), DHT CX (1,1), ET ATX (1,1), NPT TFF (1), 15, 15, 1, 0
       IF (IGO.EQ. 1.0R.IGO.EQ.11.0R.IGO.EQ.21) WRITE (8,1000) TFFHPS, bl.
       IF (IGO.EQ. 2.OR.IGO.EQ.12.OR.IGO.EQ.22) WRITE (8,1000) TFFHPS, WHI
       IF (IGC.EQ.10.0R.IGO.EQ.12.0R.IGO.EQ.12) WRITE (8,2000) CNHPS, WLO
       IF (IGO.EQ. 20.OR. IGO.EQ. 21.OR. IGO.EQ. 22) WRITE (8, 2000) CNHPS, WHI
1000
      FORMAT(19H0****TFFHP OFF MAP, F10.4, 2XA6, 11H**** $$$$$$)
      FORMAT(19H0++++ CNHP OFF MAP, F10.4, 2XA6, 11H+++++$$$$$$)
2000
       IF (IGO.NE.7) GO TO 3
      CALL ERROR
       RE TURN
```

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3
       MA PGO=0
       IF (ABS(TFFHPS-TFFHP).LE. 0. 001+TFFHPS) GO TO 4
       MAPGO=1
       IF (ABS(CNHPS-CNHP).GT.0.001+CNHPS) MAPGO=3
       GO TO 5
       IF (ABS(CNHPS-CNHP).GT.0.001+CNHPS) MAPGO=2
       IF (MAFGO.GT.O) CALL MAPBAC(1, MAFGC, TFFHPS, TFFHP, CNHPS, CNHP, PCNC,
5
     1T4, MODE, NOKAP, NUMMAP)
       IF (NOMAP.GT.O) RETURN
       TFHCAL=HG4+SQRT (T4) / (14.696+P4)
       ETUEXT=0.706705*HPEXT
       DHTCC=(BTUEXT+WAC+(H3-H22))/(WG4+T4)
       IF (IDES.EQ.0) GO TO 6
       TF HPCF=TFHPDS/TFHCAL
       OH HPCF=DHTCC/DHTCHP
       ET HPCF=ETHPDS/ETATHP
       WRITE (6, 102) CNHPCF, TFHPCF, ETHPCF, CHHPCF
       FORMAT(20HOH.P. TURBINE DESIGN, 5X7HCNHPCF=, E15.8, 8H TFHPCF=, E15.8,
102
      18H ETHPCF=.E15.8.8H DHHPCF=,E15.8)
6
       TFHCAL=TFHPCF+TFHCAL
       DHTCHF=DHHFCF+DHTCHP
       ETATHP=ETHPCF*ETATHP
       UHTC=DHTCC+T4
       ERR(1)=(TFHCAL-TFFHP)/TFHCAL
       ERR(2)=(DHTCC-DHTCHP)/DHTCC
       CALL THTURE (CHTC, ETATHP, FAR4, H4, S4, P4, T45, H45, S45, P45)
       IF (BLHP.LE.G.) GO TO 7
       FAR45=WFB/(WA3+BLHP)
       HG45=HG4+BLHF
       H45=(8LHPI*H22+8LHPC*H3+NG4*H45)/NG45
       CALL THERMC(F45.H45.T45.S45.XX2.1.FAR45.1)
       GO TO 8
 7
       FAR45=FAR4
       HG 45 = HG4
       CALL CCIPTE
       RETURN
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END

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SUBROUTINE CCIPTB
     COMMON/
                 ALL/
                            ,KDES
                                    , MODE
    1 NO RO
            , IDES
                   ,JDES
                                             , INIT , IDUPP , IAHTP ,
    2 IG ASMX. IOBURN. IAFTBN. IOCO
                                    .IMCD
                                            , IDSHOC, IMSHOC, NOZFLT.
    3 IT RYS, LOCPER, NOMAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
     COMMON/DESIGN/
    1PCNFGU ,PCNIGU ,PCNCGU ,T4GU
                                         , DUMD1
                                                   .DELFG
                                                            , DELFN
                                                                     .DELSFC .
             , PCNFDS , PRFDS
                                                            , ETAFCF , WAFCF
    2 ZF DS
                                , ETAFOS , HAFDS
                                                   ,PRFCF
                                                   ,PRICF
    3 ZI OS
             , PC NIDS , PRIDS
                                , ETAIDS , WAIDS
                                                            , ETAICF , WAICF
                                                   ,PRCCF
    4200S
             , PCNCES , PRCDS
                                , ETACOS , WACOS
                                                            , ETACCF , HACCF
    5 T4 DS
             , WF EDS
                       ,DTCODS ,ETABOS , WA3CDS ,DPCODS ,DTCOCF ,ETABCF
    6 TF HPOS , CN HPOS , ETHPOS , TF HPCF , CN HPCF , ETHPCF , DH HPCF , T2DS
    7 TF IPOS , CNIPOS , ETIPOS , TFIPCF , CNIPCF , ETIPCF , OHIPCF , T210S
    87FLPDS , CNLPCS , ETLPDS , TFLPCF , CNLPCF , ETLPCF , DHLPCF , T22DS
                       , DTDUDS , ETADDS , WAZZOS , DPDUDS , DTDUCF , ETADCF
    9 T2 40S
             . WF CDS
    A T7 OS
             , HF ADS
                       ,DTAFDS ,ETAADS , NG6CDS ,DPAFDS ,DTAFCF ,ETAACF
                       , A6
                                , A7
                                         ,AE
                                                   ,A9
                                                            ,A28
                                                                     ,A29
    B 455
             . A25
    CPS 55
             , AM 55
                       ,CVDNOZ ,CVMNOZ ,AESAV
                                                   ,A9SAV
                                                            ,A28SAV ,A29SAV
     COMMON/ FRONT/
                                ,51
                                         ,12
                                                   ,P2
    171
             , P1
                       ,H1
                                                            .H2
                                                                     , S2
    2121
             , 621
                       ,H21
                                , 521
                                         ,122
                                                   ,P22
                                                                     , S22
                                                            ,H22
             , P3
                                         ,T4
    3 T3
                       , H3
                                • S3
                                                   .P4
                                                            ,H4
                                                                     ,54
                                         ,T5
                                                   ,P5
    4145
             . P45
                       ,H45
                                ,545
                                                            , H5
                                                                     , $5
    5155
             , P55
                                , 555
                                         ,BLF
                                                            , BLC
                       , H55
                                                   .BLI
                                                                     , BLDU
    6 CN F
             . FRF
                       ,ETAF
                                , WAFC
                                         , WAF
                                                   ,BLDUI
                                                            ,B_DUC
                                                                    -,BLOB
                                , HAIC
                                         , HAI
    7 CN I
             , PRI
                       ,ETAI
                                                   .BLOBI
                                                            .BLOBC
                                                                     , HA3
                                         , HAC
             , PRC
                                , HACC
    8 CHC
                                                            , DPCOM
                       , ETAC
                                                   ,ETAB
                                                                     . HG4
                                         ,BLHP
    9 CN HP
             , ETATHE
                       , DHT CHP
                                , DHTC
                                                   ,BLHPI
                                                            , BLHPC
                                                                     ,FAR4
                                         ,BLIP
                       , OHT CIP
                                , DHTI
                                                   ,BLIPI
                                                            , BLIFC
    ACNIP
             , ETATIP
                                                                     , DUMF
             , ETATLP
                       , DHT CLP
                                         , BLLP
                                                   ,BLLPI
                                                            , BLLPC
                                                                     , CS
    BCNLP
                               ,OHTF
                       , HG5
                                ,FAR5
    C NG 45
             ,FAR45
                                         , NG55
                                                   ,FAR55
                                                            , HPEXT
                                                                     .AH
                       ,ZF
                                , PCNF
                                         , Z I
    DALTP
             , ETAR
                                                   ,PCNI
                                                            ,ZC
                                                                     , PCNC
             , TF FHP
                       ,TFF IP
                                , IFFLP
                                         , PCBLF
                                                                     ,PCBLDUI,
                                                   ,PCBLI
                                                            , PCBLC
    FFC BLOUC, PC EL CBI, PCBLOBC, PCBLHPI, PCBLHPC, PCBLIPI, PCBLIPI, PCBLLPI,
    GPCBLLPC
     COMMON/ITURB/TFFX(15), CNX(15,15), CHTCX(15,15), ETATX(15,15),
    1 NT FFS, NPTT FF (15)
     DATA ANORD, WLO, WHI/6HCOIPTB, 6H (LC), 6H (HI) /
     HORD = AWORD
     IF (IDES.EQ.O) GG TO 1
     CN IPCF=CNIFDS+SQRT(T45)/PCNI
     CN IP=CNIPCF+PCNI/SQRT(T45)
     CN IPS = CNIP
     TFFIPS=TFF IP
     CALL SEARCH(-1., TFFIP, CNIP, DHTCIP, ETATIP,
    1 TFFX(1), NTFFS, CNX(1,1), OHTCX(1,1), ETATX(1,1), NPTTFF(1), 15,15, IGO
     IF (IGO.EQ. 1.OR.IGO.EQ.11.OR.IGO.EQ.21) WRITE(8,1000)TFFIPS, HLC
     IF (IGC.EQ. 2.0R.IGO.EQ.12.0R.IGO.EQ.22) WRITE (8,1000) TFF IPS, WHI
     IF (IGO.EQ. 10.0R.IGO.EQ.11.0R.IGO.EQ.12) WRITE (8,2000) CNIPS, WLO
     IF (IGO.EQ. 20.0R.IGO.EQ. 21.0R.IGO.EQ. 22) MRITE (8, 2000) CNIPS, WHI
1000 FORMAT(19H0++++TFFIP OFF MAP,F10.4,2XA6,11H+++++$$$$$$)
2000 FORMAT (19H0+++++ GNIP OFF MAP, F10.4, 2XA6, 11H+++++$$$$$)
     IF (IGO.NE.7) GO TO 3
     CALL ERROR
     RE TURN
```

**你还能活动与20%,这点的现在的结构的对对的**的图 **6**334

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3
     MA PGO=0
     IF (ABS(TFF IPS-TFFIP).LE.Q.Q01+TFFIPS) GO TO 4
     IF (ABS(CNIFS-CNIF).GT.O.001+CNIPS) MAPGO=3
     GO TO 5
     IF (ABS(CNIPS-CNIP).GT.0.001*CNIPS) MAPGO=2
     IF (MAPGO.GT.0) CALL MAPBAC(3, MAPGC, TFFIPS, TFFIP, CNIPS, CNIP, PCNI,
    1 T4, MODE, NO MAP, NUMMAP)
     IF (NCPAP.GT.0) RETURN
     TF ICAL=HG45+SQRT (T45) / (14.696+P45)
     DHTIC=(MAI+(H22-H21))/(MG45+T45)
     IF(IDES.EG.O) GO TO 6
     TF IPCF=TFIPDS/TFICAL
     OHIPCF=OHTIC/OHTCIP
     ET IPCF=ETIFDS/ETATIP
     WRITE (6, 102) CNIPCF, TFIPCF, ETIPCF, CHIPCF
     FORMAT(20HOI.P. TURBINE DESIGN, 5X7HCNIPCF#, E15.8, 8H TFIPCF=, E15.
    18H ETIPCF=,E15.8,8H DHIPCF=,E15.8)
     TFICAL=TFIPCF=TFICAL
     OHTGIP=DHIFCF+DHTCIP
     ETATIP=ETIFCF*ETATIP
     DHTI=DHTIC=T45
     ERR(8)=(TFICAL-TFFIP)/TF1CAL
     ERR(9)=(DHTIC-DHTCIP)/DHTIC
     CALL THTURE (OHTI, ETATIP, FAR45, H45, S45, P45, T5, H5, S5, P5)
     IF (BLIP.LE.O) GO TO 7
     FAR5 = WF8/(WA3+8LHP+BLIP)
     MG5=NG45+BLIP
     H5=(BLIPI+H22+BLIPC+H3+WG45+H5)/WG5
     CALL THERMO(P5, H5, T5, S5, XX2, 1, FAR5, 1)
     GO TO 8
     FAR5=FAR45
     NG 5 = NG 45
     CALL COLPTE
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RETURN END

```
SUBROUTINE CCLPTB
     COMMON /
                  ALLI
                                   , MODE , IHIT , IDUNP , IAHTP ,
                    JDES ,KDES
            , IDES
    1 FORD
    2 IGASNX, IDBURN, IAFTBN, IDGO , INGD , IDSHOG, INSKOC, NOZFLT,
    3 IT RYS, LOOPER, NOMAP, NUMMAP, HAPEDG, TOLALL, ERR (9)
     COMMON/DESIGN/
                                          ,DLHD1
                                                   JUELFG
                                                            , DELFN
                                                                     , DELSFC ,
    1PCNFGU ,PCNIGU ,PCNCGU ,T4GU
                                                   ,PRFCF
                                                            ETAFOF , WAFOF
                                ETAFOS , NAFOS
              ,PCNFDS ,PRFDS
    2 ZF 03
                                                   ,PRICF
                                                            , ETAIGF
                                                                     HAICF
                                , ETAIDS , WAIDS
    3ZI DS
              , PCKIES , PRIDS
                                                   ,PRCCF
                                                            ETACCE
                                                                     , HACCF
                                ,ETACOS , HACOS
              .PCNCSS ,PRCBS
    4 ZC DS
                       ,OTCOOS ,ETABOS , HASCOS ,OPCODS , DTCCCF , ETABCF
    5T40S
              , WF EDS
              CONHOUS , ETHEOS , TEHPOF , CONHOCE , ETHPOF , OHHPOF , T205
    6 TF HP DS
    TIFIPDS , CNIPOS , ETIPOS , TFIPCF , CAIPOF , ETIPOF , OHIPCF , T210S
                                                   ETLPCF , OHLPCF , T220S
    STFLPOS, CHLPOS, ETLPOS, TFLPCF, CHLPCF
                       , OTOUGS , ETAODS , MA230S , OPOUGS , OTOUGF , ETAOCF
              , XFODS
    912405
                       , DTAFOS , ETAADS , NGGCDS , DPAFDS , DTAFCF , ETAACF
    AT7 DS
              , HF ADS
                                                   ,49
                                                                      ,A29
                                , A?
                                          , 48
                                                             , A28
                       , 46
    B A5 5
              , A25
                                                            , AZESAV , AZESAV
                       ,CVDNOZ ,CVMNGZ ,AESAY
                                                   ,A9SAV
    CPS 55
              , AM 55
      COMMON/ FRONT/
                                                             , H2
                                                                      <sub>2</sub> S2
                                          ,72
                                                   , P2
                       , H1
                                , S1
              , F1
    1 T1
                                          , 722
                                                                      ,522
                                ,521
                                                   #22
                                                             3H22
              1 Sq,
                       ,H21
    2721
                                          , F4
                                                   :74
                                ,53
                                                             .H4
                                                                      ,54
              , 93
    3 13
                       .K3
                                                   ,P5
                                                             , H5
                                                                      ,55
                                          ,15
              , 145
                       , H45
                                ,545
     4145
                                                                      , HLBU
                                          ,BLF
                                                   ,BLI
                                                             , Bt.C
              , P55
                                .555
    5 15 5
                       , H55
                                                                      , BL 08
                                          SHAF
                                                   ,BLOUI
                                                             . RLDUC
                                , WAFC
                       ETAF
    6 CNF
              , PRF
                                                                      , HA3
                                                   , BLOGI
                                                             ,BLOBC
                                          ICH,
              , PRI
                                 , HAIC
    7 CM I
                       ,ETAI
                                                                      , HG4
                                                             , DPCOM
                                , WACC
                                          , WAC
                                                   ,ETAB
              PRC
                       ,ETAC
     & CNC
                                                                      .FAR4
                                          , BLHP
                                                             , BLHPC
                       , OHTCHP , DHTC
                                                   .BLHPI
              , ET ATHP
     9 CN HP
                                                   ,BLIPI
                                                                      , DUMF
                                                             , ALIPC
              , ETATIP , OHTGIP , OHTI
                                          , BLIP
     A CN IP
                                                                      ,CS
                                                             , BLLPG
                                          ,SLLP
                                                    BLEPI
              , ETATLP , OHT CLP , OHTF
     BCNLP
                                                                      , AM
                                          , NG55
                                                             , HPEXT
                                 , FARS
                                                   ,FAR55
                        . NG5
              ,FAR45
     C NG 45
                                                                      , PCHC
                                          , 2 %
                                                    ,PCNI
                                                             , ZC
                        , ZF
                                 , FCNF
              , ET AR
     DALTP
                                                             ,PCBLC
                                                                      , PCBL BUI,
                                          , PCBLF
                                                    ,PCBLI
                       ,TFF IP
              , TEFHP
                                 , TFFLP
     ENFB
     FPCBLOUC, PCBLOBI, PCBLOBC, PCBLHPI, PCBLHPC, PCBLIPI, PGBLIPC, PCBLLPI,
      COMMON /LTURB/TFFX(15), CNX(15,15), DHTCX(15,15), ETATX(15,15),
     1 NT FFS, NPTT FF (15)
      DATA AWORD, NLO, NHI/6KCOLPTB, 6H (LC) , 6H (HI) /
      HORD = AWORD
      IF (IDES.EQ.0) GO TO 1
      CNLPCF=CNLFBS*SQRT(T5) &PCNF
      CNLP=CNLFCF*FCNF/SQRT(T5)
      CNLPS=CNLP
      TFFLPS=TFFLP
      CALL SEARCH (-1., IFFLP, CNLP, DHTCLP, ETATLP,
     1 TFFX (1), NT FFS, CNX (1,1), DHTGX (1,1), ETATX (1.1), NPTTFF (1), 15, 15, 160)
      IF (TGO.EQ. 1.CR.IGO.EQ.11.QR.IGO.EQ.21) WRITE (8,1000) TFFLPS, HLO
      IF (IGO.EQ. 2.0R.IGO.EQ.12.0R.IGO.EQ.22) WRITE(8,1000) TFFLPS, WHI
      IF (IGQ.EQ. 14.OR.IGO.EQ.11.OR.IGO.EQ.12) WRITE (8,2000) CNLPS, WLQ
      IF (IGO.EQ. 20. QR. IGO.EQ. 21. QR. IGO. EQ. 22) WRITE (8, 2000) CNLPS, WHI
      FORMAY (19HO*****TFFLP OFF MAP, F10.4, 2XA6, 11H***** $$$$$$)
1000
      FORMAT(19H0++++ CNLP OFF MAP, F10.4, 2XAG, 11H++++$18888)
200 u
       IF (IGC.NE. ?) SO TO 3
      SALL ERROR
      RE TURN
```

A STATE OF THE PARTY OF THE PROPERTY OF THE PR

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PAPGOOR
3
      IF (AUS (TFFLPS-TFFLP).LE.O.001+TFFLPS) GO TO 4
      MAMGO=1
      IF (ABS (CNLPS-CNLP).ST.O.081+CNLPS) MAPGO=3
      GO FO B
      注 (ABS(CNLPS+CNLP).GT.0.881+CNLPS) HAPGO=2
      IF (MAPGO.GT. 8) CALL MAPBAC(2, MAPGO, TFFLPS, TFFLP, CNLPS, CNLP, PCNF,
     1 T4, HODE, NOMAP, NUMMAP)
      IF (NOMAP.GT.G) RETURN
      TFLCAL=HG5+SGRT (T5) / (14.696+P5)
      OHTCF=WAF+ (H21~H2) / (NG5+75)
      IF (IDES.EQ.9) GO TO 6
      TFLPCF*TFLPDS/TFLCAL
      CHLPGF=OHTCF/OHTCLP
      ET LPCFEETL FOSZETATUP
      WRITE (G, 102) CNLPGF, TFLPGF, ETLPGF, CHLPGF
102
      FORMAT (20HOL.F. TURBINE DESIGN, 5x7HCNLPCF=, E15.8, 8H TFLPCF=, E15.8
     18H ETLPCF=, 215, 8,8H DHLPCF=, E15.8)
      TFLCAL#IFLPGFFTFLGAL
6
      OH TOLP=DHLPCF+DHTCLP
      ETATLP=ETLPCF+ETATLP
      OHTF=OHTCF+T5
      ERR(3)=(TFLCAL-TFFLP)/TFLCAL
      ERR(4)=(DHICF-DHTCLP)/DHTCF
      CALL THTURB (OHTF, ETATLP, FAR5, H5, S5, P5, T55, H55, S55, P55)
      IF (BLLP.LE.G.) GO TO 7
      FAR55=WFB/(WA3+R/.HP+BLIP+BLLP)
      NG 55=NG5+BLLP
      H55=(BLLP1+H22+BLLPC+H3+NG5+H55)/NG55
      CALL THERMO(F55, H55, T55, S55, XX2, 1, FAR55, 1)
          GO TO 8
      FAR55=FAR5
7
      NG 55 = NG5
      CALL FRIOSC
      RETURN
      END
```

THE PERSON OF TH

```
SUBROUTINE FRIOSD
 COMMON/ FRONT/
                                                  ,P2
171
          . F1
                    .HI
                              * S1
                                        ST.
                                                            SH.
                                                                      .52
          , 521
                    ,H21
2121
                              . $21.
                                        ,722
                                                  .P22
                                                            . H22
                                                                      $22
          cP3
                    5 H3
                                        ,74
                                                  , P4
                                                            , H4
313
                              , 53
                                                                      ,54
4745
          ,P45
                    , H45
                              , $45
                                        ,15
                                                  ,95
                                                            , H5
                                                                      , $5
          , P55
                    , H55
                              , 555
                                        ,BLF
                                                  , BLI
5 T5 5
                                                            , SLC
                                                                      . BLOU
          .PRF
                    , EI AF
                                        , KAF
                              . HAFC
                                                            , BLDUC
                                                                      ,BLOB
5 CNF
                                                  .BLDUI
          , PRI
                    ,ETAI
                              , WAIC
                                        SHAI
                                                            ,BLOSC
                                                                      , HA3
Z ON X
                                                  .BLOBI
                    *ETAC
                              , HACC
                                                            , OPCOM
8 CNC
          , PRC
                                        , HAC
                                                  ,ETAB
                                                                      , MG4
                    , DHT CHP
9 CX HP
          , ETATHP
                                                  ,BLHPI
                                                            , BL HPC
                              . CHTC
                                        , BLHP
                                                                      FAR4
                    , OHYCIP
          SETATIP
                              , DHTI
                                        ,BLIP
                                                  ,BLIPI
                                                            , BLIPC
                                                                      , DUNF
ACNIP
                    , DET CLP
                              , OHTF
                                        ,BLLP
          , ETATLP
                                                            ,BLLPC
                                                                      .cs
BCNLP
                                                  ,BLLPI
                    , HG5
                              ,FARS
                                        , NG55
                                                            , HPEXT
CHG45
          ,FAR45
                                                  FAR55
                                                                       HA q
DALTF
                    , ZF
                              . PCNF
                                                                      .PCNC
          , ET AR
                                        .21
                                                  .PCNI
                                                            .ZC
                    ,TFF IP
          , TFF4P
                              ,TFFLP
                                        ,PCBLF
                                                  ,PCBLI
                                                            * PCBLC
                                                                      ,PC8LDUI,
ENFB
FFC BLDUC, PC BLOBI, PCBLOBC, PCBLHPI, PCBLHPC, PCBLIPI, PCBLIPI, PCBLLPI,
GPCBLLPC
 COMMON/
            SIDE
                    , XHAI
          , XHAF
                              , XHAC
                                        , XELF
                                                  ,XSLCU
1 XP1
                                                            ,XBLOUI ,XBLOUC
                    , XTC1
          , XH 3
                              , XP21
2 XH 22
                                        . XH21
                                                  .XSZ1
                                                            .DUXS1
                                                                      , DUNS 2
                    ,H23
                              , $23
                                                  ,P24
          ,723
                                        ,724
3723
                                                            , H24
                                                                       ,524
                    , N25
                                                  ,P28
                                                                      ,329
4 T2 5
          , P25
                              , 525
                                        ,725
                                                            , H28
                    2H29
                              ,529
                                        , CUNS3
                                                            , DUNS 5
5 T2 9
          , 729
                                                  ,BUKS4
                                                                      . DUNS 6
                    , KG24
                              FAR24
                                        , ETAD
                                                  , npouc
                                                            ,BYPASS , DUMS 7
6 MAD
          , HFL
7 TS 29
          , PS 28
                    85V.
                              BSHA,
                                        .TS29
                                                  ,PS29
                                                            , V29
                                                                      ,AMZS
 XP1=P1
 XWAF = HAF
 IAH=IAHK
 XHAC= HAC
 XBLF=ELF
 XBLOU=8LOU
 X8LDuI=BLDuI
 XBLDUC=BLOUC
 XH 22 = H22
 XH3=H3
 XT 21=T21
 XP 21 = F21
 XH21=H21
 XS 21=521
 CALL CODUCT
 RE TURN
 END
```

```
SUBROUTINE CODUCY
 COMMON /
              ALL/
                        , KDES
                                , MODE
       ,IDES ,JOES
                                       , INIT
                                                , IDUMP , IAHTP .
2 IGASHX, IDBURN, LAFTBN, LOCO
                                ,IHCD
                                        , IDSHOC, INSHOC, NOZFLT,
3 ITRYS, LOOPER, NOMAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
 COMMON/DES IGN/
1PCNFGU , PCNIGU , PCNCGU , T4GU
                                     , GUND1
                                              ,DELFG
                                                       , DELFN
                                                                 ,DELSFC ,
2 ZF DS
         ,PCNFOS ,PRFOS
                            , ETAFDS , HAFDS
                                              .PRFCF
                                                       ,ETAFCF
                                                                , WAFCF
3 ZI DS
         ,PCNISS ,PRIDS
                            , ETAIDS , HAIDS
                                              ,PRICF
                                                       , ETAICF
                                                                . WAICF
4ZCDS
         , PCNCDS , PRCDS
                            , ETACDS
                                     , HACDS
                                                       ,ETACCF
                                                                , WACCF
                                              ,PRCCF
                  ,DTCODS
5 T4 DS
         , WF EDS
                            , ETABOS , WASCOS , DPCQDS , DTCOCF , ETABCF
6TF HPDS
         . CN HPDS
                  ,ETHPDS
                            ,TFHPCF PCNHPCF ,ETHPCF ,DHHPCF ,T20S
7 TF IPDS
         , CN IFDS
                  ,ETIPOS ,TFIPCF
                                     ,CNIPCF ,ETIPCF ,DHIFCF ,T210S
STFLPDS , CNLPDS , ETLPDS , TFLPCF , CNLPCF
                                             ,ETLPGF ,DHLPGF
                                                                ,T220S
9 T2 4 DS
         . WF CDS
                  ,DTDUDS ,ETADOS , RA23DS
                                              .OPDUOS .DTDUCF
                                                                , FTADEF
AT7 DS
         , WF ADS
                   ,OTAFDS ,ETAADS
                                    , WG6CDS
                                              DPAFDS .DTAFCF
                                                                .ETAACF
B A5 5
         ,A25
                            ,A7
                   , A6
                                     , A8
                                              ,A9
                                                       , A28
                                                                , A29
CPS 55
         , AM 55
                  ,CVDNOZ ,CVHNOZ ,ASSAV
                                              ,A9SAY
                                                       ,A28SAV ,A29SAV
 COMMON!
           SIDE
         , HAF
                  , HAI
1 P1
                            , HAC
                                     , ELF
                                              , BLDU
                                                       , BLOUI , BLOUC
2 H 22
         , H3
                  , T21
                            , P21
                                              , 521
                                                       , DUMS1
                                                                , DUMS 2
                                     , H21
3123
         , F23
                            ,523
                  .H23
                                     , T24
                                              ,P24
                                                       ,H24
                                                                ,524
4125
         , P25
                   ,H25
                            ,S25
                                     ,T28
                                              ,P28
                                                       ,H28
                                                                , S28
5 T2 9
         , P29
                   ,H29
                            , S29
                                     ,DUMS3
                                                       , DUMS 5
                                                                , DUHS 6
                                              DUMS4
6 MAD
         , HFC
                                     , ETAD
                                                                ,DUNS7
                   , HG24
                            ,FAR24
                                              DPOUC
                                                       , BYFASS
         , PS 28
7 TS 28
                            SSHA,
                  , V28
                                     , TS29
                                              , rS29
                                                       , V29
                                                                , AM29
 DIMENSION Q(9)
 DATA ANDRO1, ANORD2/6HCODUCT, 6HDNOZZL/
 HORD = AWORD 1
 Q(2)=0.
 Q(3) = 0.
 WAX=HAF-KAI-BLF
 HAD=WAX+BL CU
 P23=P21
 H2 3= (BLDUI +H22+BLDUC+H3+HAX+H21)/WAD
 CALL THERMC(F23, H23, T23, S23, XX2, 1, 0.0, 1)
 BY PASS= (HAF-HAI) /WAI
 MA 23C=WAD+SORT (723) /P23
 IF (IDES.EO.1) WAZZUS=WAZZC
 OPDUC=DPDUDS*(WA23C/WA23DS)
 IF (OPOUC.GT.1.) OPDUC=1.
 P24=P23+(1.-CPDUC)
 IF (IGASMX.GT.O) IDBURN=0
 If (IDBURN.NE.O) GO TO 2
 T24=T23
 WFD=0.
 FAR24=0.
 IF (IDBURN. EQ. 2) T24=T23+2000.
 IF (T24,G1.4000.) T24=4000.
 IF (T24.LT.T23) T24=723
 IF
    DESIRED, ENTER CALCULATIONS FOR ETAD HERE
 HV=({(((--4594317E-19*T24)-.2034116E-15)*T24+.2783643E-11)*T24+
1.2051501E-U7) *T24-.2453116E-03) *T24-.9433296E-01) *T24+.1845537E+.
 GALL THERNC(P24, HA, T24, XX1, XX2, 0, 0.0.0)
```

であるというなのできるからあったられるというと

一、一般の情報の情報のないないのでは、一般なるないできないというできます。 かんせいしん

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2

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FAR24=(HA-H23)/(HV+ETAG)
      IF (FAR24.LT.O.) FAR24#0.
      kenx=FAR24 WAD
      IF (IDEURN , NE. 2) GO TO 6
      ERRH= (KFO~ HFOX) /HFO
      DIR=SCRT (WFD/WFCX)
      CALL AFOUIR(0(1), 724, ERRH, 0., 29, 0.0001, DIR, 7247, IGO)
      GO TO (4,7,5), IGO
      T24=T24T
      GO TO 3
5
      CALL ERROR
      HED=HEDX
6
      CALL THERMO(F24, H24, T24, S24, XX2, 1, FAR24, 0)
      HG 24 = KFD+HAD
       IF (IDES.EQ.1) WRITE (6,101) WA230S
      FORMAT(12HODUCT DESIGN, 12x8H WA23CS=,E15.8)
101
  *** IF DESIRED, ENTER OTHER LOSSES HERE
       125=T24
      P25=P24
      125=H24
      525=524
       IF (IGASMX.GT.0) GO TO 11
       WORD = AWORD 2
       A2 85 A V= A 28
       A2 9SA V= A29
       NO ZD = 0
       IDNOZ=0
       IF (NOZFLT.ED.2.OR.NOZFLT.EG.3) NOZD=1
       IF (IDES.EQ.1.OR.IDBURN.GT.0.OR.NOZD.EQ.1) IDNOZ=1
       IF (IOCD.EC.1) GO TO 8
       CALL CONVRG(T25, H25, P25, S25, FAR24, MG24, P1, IDNOZ, A28,
                                                                      P25R .
     1 T2 6, H28, P2 &, S28, TS28, PS28, V28, AM28, ICON)
       GO TO (9,9,3,5), ICON
      CALL CONDIV: T25, H25, P25, S25, FAR24, MG24, P1, IDNOZ, A28, A29, P25R,
     1728,H28,P28,528,T29,H29,P29,S29,T528,T529,PS28,PS29,V28,V29,A~
     2 AM 29 . ICON)
       ID SHOC= I CON
       59 TO (10,10,10,5), ICCN
       T29=T28
       +29=H28
       F29=P28
       529=528
       1529=1528
       PS29=PS28
       v2 9= V28
       AM 29 = AM28
       85 A= 6 SA
       IDSHOC=ICON+3
10
       ERR(5)=(F25R-F25)/P25R
       IF (IDNOZ, EQ. 1) WRITE (6, 100) A28, AM28, A29, AM29
. 00
       FORMAT (19HODUCT NOZZLE DESIGN, 5X8H
                                                  A28=,E15.8,8H
                                                                    AM28=, 61
             A29=,E15.8,8H
                               AM29=,E15.8)
     18H
       CALL FASTBK
4 -
       RE TURN
       ENC
```

```
SUBROUTINE FASTEK
 COMMON/ FRONT/
                                                   ,P2
171
          , P1
                    ,H1
                              ,51
                                         , T2
                                                             , H2
                                                                       , $2
2T21
          ,P21
                    ,H21
                              ,521
                                         ,T22
                                                   ,P22
                                                             ,H22
                                                                       ,522
                                                   ,P4
          , P3
3 T3
                    , H3
                              , $3
                                         , T4
                                                                       ,54
                                                             , H4
          ,P45
                               ,545
                                         ,T5
                                                   ,P5
                                                             , H5
4745
                    . H45
                                                                       , 55
          , P55
                              , $55
                                                   ,BLI
                                                                       , BLOU
5155
                    ,H55
                                         ,BLF
                                                             ,BLC
          , PRF
                    , ETAF
                              , HAFC
                                         , HAF
                                                   , BLDUI
                                                             , BL DUC
6 CN F
                                                                       ,8L08
          ,PRI
                              , WAIC
                                         , WAI
                                                   ,BLOBI
                                                             , BLOBC
                    .ETAI
                                                                       , HA3
7 CN I
                                         , HAC
          , PRC
                    ,ETAC
                               , HACC
                                                             , DPCCH
8 CN C
                                                                       , WG4
                                                   ,ETAB
9 CNHP
          , ET AT HP
                    , OHT CHP
                              , DHTC
                                         ,BLHP
                                                             , B: HPC
                                                                       .FAR4
                                                   ,BLHPI
                                                             OF APC
                    , DHTCIP
                              , DKTI
                                                   ,BLIPI
A CN IP
          , ET AT IP
                                         ,BLIP
                                                                       . DUMF
          SETATLE
                    , DHTCLP
                              , DHTF
                                         , BLLP
                                                             , L& LPC
                                                                       , CS
BCNLP
                                                   ,BLLPI
                    , NG5
                              ,FAR5
          ,FAR45
C NG 45
                                         , HG55
                                                   ,FAR55
                                                             , MPEXT
                                                                        , AH
                    ,ZF
                              , PCNF
DALTP
          , ETAR
                                         ,ZI
                                                   ,PCNI
                                                             ,ZC
                                                                        , PCNC
                                         ,PCBLF
E KF 8
          ,TFFHF
                    ,TFFIP
                              , TFFLP
                                                   ,PCBLI
                                                             , PCBLC
                                                                       ,PCBLOUI,
FPCBLDUC, PCBLOBI, PCBLOBC, PCBLHPI, PCBLHPC, PCBLIPI, PCBLIPC, PCBLLPI,
GPC BLLFC
 CO MMON/
            SIDE/
          , XH AF
                               , XWAC
                                         , XBLF
                                                   ,XBLDU
1XP1
                     , XHAI
                                                             ,XBLDUI ,XBLDUC
          , XH3
                     , XT21
                               , XP21
                                                             ,DUMS1
                                         , XH21
                                                                       , DUMS 2
2 XH22
                                                   ,XS21
3123
          ,P23
                     ,H23
                              , 523
                                         ,T24
                                                             ,H24
                                                                       ,524
                                                   ,P24
          , P25
                                         ,T28
                                                   ,P28
                                                             ,H28
                                                                       ,S28
4T25
                    ,H25
                               , 525
5T29
          , P29
                    ,H29
                               , 529
                                         , DLMS3
                                                   ,DUMS4
                                                             ,DUHS5
                                                                       , DUNS 6
                               ,FAR24
          , WFD
                    , HG24
                                         ,ETAD
                                                   , DPDUC
                                                             , BYPASS
6 HA D
                                                                       •DUNS7
          ,PS28
                     , V28
                               , AH28
                                         ,TS29
                                                   ,PS29
                                                             , V29
                                                                       , AH29
71528
              EACK/
 COMMON /
         , XP55
                  ,XH55
                           ,XS55
                                    ,XT25
                                             , XP25
                                                     , XH25
X XT 55
                                                              , XS25
         , XHG55 , XFAR55, XHFD
XXHFB
                                    ,XHG24 ,XFAR24,XXP1
                                                              ,DUMB
         ,P6
                                   , T7
                                            , P7
                  ,H6
                           ,56
                                                     , H7
3 T 6
                                                              ,57
                                    ,T9
                  ,H8
4 T8
         , P8
                           ,58
                                             , P9
                                                     ,H9
                                                              ,59
                           ,FAR7
                                    , ETAA
5 NG 6
         , WFA
                  ,WG7
                                             , OPAFT , V55
                                                              , V25
                           ,TS7
                                    ,PS7
                                             , V7
                                                     ,AH7
                  ,AK6
                                                              , AH25
6 PS 6
         , V6
         , FS8
                           ,AHB
                                             , PS9
                                                     , V9
                                                              , AM9
7 TS 8
                  , V 8
                                    ,TS9
                           ,FGMD
                                   , VJH
                                             , FGMH
                                                     ,FGPD
8 VA
         ,FRD
                  ,VJD
                                                              , FGPH
9FGM
         , FGP
                  , HFT
                           , NGT
                                    , FART
                                             ,FG
                                                      ,FN
                                                              ,SFC
 XT 55 = T55
 XP 55 = F55
 XH55=H55
 XS 55=S55
 XT 25= 125
 XP 25 = F25
 XH 25 = 125
 XS 25 = S25
 XWF8=#FB
 XW G55=KG55
 X7 AR55=FAR55
 XW FO = WFO
 XH G2 4 = HG 24
 XF AR24=FAR24
 XX P1 = F1
 CALL COMIX
 RETURN
 END
```

Section .

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THE PERSON IN THE PARTY OF THE PERSON OF THE

```
DIMENSION QQ (9)
      COMMON /
             , IDES
                                      , MODE
                             , KDES
                      ,JOES
                                              , INIT , IDUMP , IAMTP ,
     2 IG ASMX, IDBURN, IAFTBN, IDCD , IMCD , IDSHOC, IMSHOC, NOZFLT,
     3 IT RYS, LOOPER, NOMAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
      COMMON/DESIGN/
                                           ,DUMD1
     1 PC NFGU , PC NIGU , PCNCGU , T4GU
                                                    ,DELFG
                                                              , DELFN
                                                                       , DELSFC
     2 ZF DS
               , PCNFGS , PRFDS
                                 , ETAFOS , WAPOS
                                                    ,PRFCF
                                                              , ETAFCF , WAFCF
               , PCNICS , PRIDS
                                 , ETAIDS , WAIDS
     3 2 I D S
                                                    PRICF
                                                              .ETAICF .HAICF
               , PCNCDS , PRCDS
                                          , HACDS
                                                              , ETACCF , WACCF
     4 ZC DS
                                 , ETACOS
                                                    .PRCCF
               , WF EDS
                        ,DTCODS ,ETABOS , WA3COS ,OPCODS ,DTCOCF ,ETABCF
     5 T4 DS
     6 TF HPDS , CNHPOS , ETHPOS , TFHPCF
                                          , CAHPCF
                                                              , BHHPCF
                                                                       ,T2DS
                                                    .ETHPCF
     7TFIPOS , CNIPOS , ETIPOS
                                 ,TFIPCF
                                           , CNIPCF
                                                    ,ETIPCF
                                                              , DHIPCF
                                                                       ,TZ1DS
     8 TF LPDS
              ,CNLPOS ,ETLPOS ,TFLPCF
                                                              , DHLPCF , T22DS
                                          , CALPCF , ETLPCF
                        ,CTDUDS ,ETADOS , WA230S , OPOUDS , DTDUCF , ETADOF
     9 T2 4DS
               , WF COS
     ATT DS
               . WF ADS
                        DTAFDS , EYAADS , NGCODS , OPAFOS , DTAFCF , ETAACF
                                           , A 8
     B A55
               , A25
                                 , A7
                                                    ,49
                                                              , A28
                        . A6
                                                                       ,A29
     C PS 55
                        ,CVDNOZ ,CVMNOZ ,A8SAV
               . AH 55
                                                    ,A9SAV
                                                              ,A28SAV ,A29SAV
      COMMON/FROAT/DUMF1(98), ZF, PCNF, DUMF2(21)
      COMMON /
                  EACK/
              ,P55
                              ,S55
                                      ,T25
                                               , P25
     1 T55
                      ,H55
                                                       ,H25
                                                               , $25
              , WG55
                      ,FAR55
                              , HFD
     2 HF B
                                                               , DUHB
                                      , HG24
                                              ,FARZ4 ,P1
             ,P6
                                      ,17
                                              , P7
                              ,56
     316
                                                       , H7
                      ,H6
                                                               ,57
             , P 8
                                              , P9
     4 T8
                              ,58
                                      ,T9
                                                               ,59
                      ,H8
                                                       , H9
                              ,FAR7
                                      ,ETAA
             , WFA
                      , NG7
                                              , DPAFT , V55
     5 NG 6
                                                               , V25
             , 46
                      ,AM6
                              ,TS7
                                              , V7
     6 PS 6
                                      ,PS7
                                                       ,AH7
                                                               , AH25
     7 TS 8
              ,P58
                      . V8
                              ,AHS
                                      ,TS9
                                               ,PS9
                                                       , V9
                                                               .AH9
              , FRD
                              ,FGMD
                                      , VJH
                                              , FGMM
                                                       , FGPQ
                                                               , FGPH
     8 VA
                      .VJD
     9 FG M
             , FGP
                              , HGT
                      ,WFT
                                      ,FART
                                               ,FG
                                                       , FN
                                                               ,SFC
      DATA AWORD/6H COMIX/
      HORD = AWORD
      AJ=778.26
      CAPSF=2116.2170
      G= 32.174049
      CALL FROCEM(FAR55, T55, XX1, XX2, XX3, XX4, PHI55, XX5)
      CALL PROCOM(FAR24,T25,XX1,XX2,XX3,XX4,PHI25,XX5)
       IF (IDES.EQ.O) GC TO 6
 *** CALCULATE A55 AND A25 WITH PS25=PS55
       IF (PS55.EQ.0.) GO TO 50
       TS55=T55+(PS55/#55)++0.286
      00 1 I=1,15
      CALL PROCOM(FAR55, TS55, CS55, AK55, CP55, REX55, PHIS55, HS55)
       PH IS = PHI 55 - REX55+AL OG (P55/PS55)
      OELPHI=PHIS-FHIS55
      IF (ABS(DELPHI).LE.O.0001*PHIS) GO TO 3
       TS 55 = TS 55 * EXF (4.0 * OELPHI)
2
      CALL ERROR
      RE TURN
50
       TS 55=0.875 +T55
      00 51 I=1,15
      CALL PROCOM(FAR95, TS55, CS55, AK55, CP55, REX55, PH1S55, HS55)
       455=AF55+C555
      HS CAL =H55- V55*+2/(2.+G+AJ)
       DELHS=HSCAL-HS55
```

SUBROUTINE COMIX

```
IF (ABS(DELHS) .LE.O. 0855+HSCAL) GO TO 52
      TS 55 = TS 55 + CELHS/CP55
51
      GO TO ¿
      #355=P55/E XP ((PHI55-PHIS55)/REX55)
52
      II (H55.GT. HS55) GO TO 53
      NR ITE (8, 101) F55, PS55, T55, TS55, H55, HS55
      FORMAT(22H OSORT OF H55-HS55 NEG ,6E15.6,6H$$$$$$)
101
      CALL ERRUR
      V55=SGRT (2.4G4AJ4(H55-HS55))
53
      RHO=CAPSF+ FS55/ (AJ+ REX55+TS55)
      A55=HG55/(RH0*¥55)
      AM 55= Y55/C S55
      IF (IGASMX.GT.0) GO TO 54
      WR ITE (6, 184) A55, AH55
                                                                 AM55=,E15.8
      FORMAT(20HOTURBINE AREA DESIGN, 6X6H A55=, E15.8, 8H
104
      GO TO 34
      PS 25 = PS 55
54
      TS25=T25+(PS25.'P25) *+0.286
      CO 4 I=1,15
      CALL FROCOM(FAR24, T325, CS25, AK25, CP25, REX25, PHIS25, HS25)
      PHIS=PHI25-REX25 ALOG (P25/PS25)
       DELPHI=PHIS-FHIS25
       IF (ABS(DELPHI).LE.0.0001*PHIS) GO TO 5
       TS25=TS25+EXP(4.0+DELPHI)
       GO TO 2
       IF (H25.GT. HS25) GO TO 55
5
       HR ITE (8, 102) F25, PS25, T25, TS25, H25, HS25
       FORMAT (22HGSQRT OF H25-HS25 NEG ,6E15.6,6H$$$$$$)
102
       CALL ERROR
       V25=SGRT (2.+G+A,J*(H25-H525))
55
       RHO=CAPSF+FS25/ (AJ+REX25+TS25)
       A25=WG24/(RHC+V25)
       AH 25= V25/C S25
       WRITE (6, 100) A55, AM55, A25, AM25
       FORMAT(25HOTURBINE/DUCT AREA DESIGN,7H
                                                  A55=,E15.8,
100
                                A25=,E15.8,8H
                                                  AN25=,E15.8)
     1 8H
            AM55= ,E15.8,8H
       GO TO 20
       CALGULATE PS55 AND PS25
       HQ A=HG55/A55
       C1 = P55+SQRT(G/(T55+AJ)) + CAPSF
       MC ON = 0
       00 (2) =0.
       QQ (3) =0.
       AM55=0.50
       TS 55 = 0.875 + 155
       00 8 I=1,15
       CALL FROCOM(FAR55, TS55, CS55, AK55, CP55, REX55, PHIS55, HS55)
       V55=AH55+CS55
       HS CAL=H55-V55**2/(2.*G*AJ)
       DELHS=HSCAL-HS55
       IF (ABS(DELHS).LE.D.0005*HSCAL) GO TO 9
       TS55=TS55+DELHS/CP55
8
       GO TO 2
       HQ AT=C1+SQRT (AK55/REX55) *AM55/(1.+(AK55-1.) *AH55**2/2.) **
9
      1 ((AK55+1.) /(2.* (AK55-1.)))
```

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AM X= AMS5
       IG 0G 0=0
      DIR=WOA/WOAT
10
       EH=(HQA-HQAT)/HQA
       CALL AFQUIR(QQ(1),AMX,EH,0.,30.,0.0005,DIR,AMXT,ICON)
       GO TO (11, 15, 2), ICON
       IF (AMXT.LE.1.0) GO TO 13
11
       AM XT = 0.7
       MC ON = MCON+1
       IF (MCON.LE.1) GO TO 13
       IF (MOCE.EQ.3) GO TO 120
       HRITE (8, 103) FCNF, AMX, F55, PS55, P25, PS25
       FORMAT(12HQCQMIX PCNF=,F7.4,4H AM=,F8.6,5H P55=,F9.5,
103
     16H PS55=,F9.5,5H P25=,F9.5,6H PS25=,F9.5,6H$$$$$$)
       PCNF=1.01*PCNF
       NOMAP=7
12
       RETURN
       WR ITE (8, 121) ZF, AMX, P55, PS55, P25, PS25
120
       FORMAT(10HOCCMIX ZF=,F8.5,4H AM=,F8.6,5H P55=,F9.5,
121
      16H PS55=,F9.5,5H P25=,F9.5,6H PS25=,F9.5,6H$$$$$$)
       ZF = 0 . 99 * ZF
       GO TO 12
13
       IF (IGOGO.EG.1) GO TO 14
       AM 55 = AMXT
       GO TO 7
       AM25 = AMXT
14
       GO TO 16
       IF (IG0G0.EQ.1) GO TO 19
15
       PS 55 = P55/E XP ((PHI55 - PHIS55)/RE X55)
       IF (IGASMX.LE.0) GO TO 34
       HQ A= HG24/A25
       C1 = P25 + SQRT (G/(T25 + AJ)) + CAPSF
       MC ON = 0
       02(2)=0.
       QQ(3) = 0.
       AM 25 = 0.25
       1S25=u.875*T25
       DO 17 I=1,15
16
       CALL PROCOM (FAR24, TS25, CS25, AK25, CP25, REX25, PHIS25, HS25)
       V2 5= A M25 *C S25
       HS CAL =H25- V25++2/(2.+G+AJ)
       DELHS=HSCAL-HS25
       IF (ABS(DELHS).LE.O. 0005*HSCAL) GO TO 18
       TS 25 = TS 25 + DEL HS/CP25
17
       GO TO 2
       HQ AT = C1 + SQRT (AK25/REX25) + AH25/(1.+(AK25-1.) + AH25++2/2.) ++
18
      1 ((AK25+1.)/(2.*(AK25-1.)))
       AMX=AF25
       IG 0G 0 = 1
       GO TO 10
       PS 25 = P25/E XP ( (PH125-PH1S25) / REX25)
19
       NG 6=NG24+NG55
       ERR(5)=(PS25-PS55)/PS25
       WF6=HFD+WFC
       FAR6=WF6/(WG6-WF6)
```

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HE = 1,1524 #H25 "N635 #H55) / N65
       CALL THERMOLIS, 115, T6, PHI6, AM: . 1, FAR. 1)
       31=PS55*A55*(1.+AK55*AM55*+2)+PS25*A25+(1.+AK25*AH25*+
       TC 6= 0. 83 (* 1 E
       Ju 25 I=1.15
       CALL FRECOP(FARE, TS6, CS6, AK6-CP6, REX6, PHIS6, HS6)
       CL = HG6+SCRT(AJ+REX6+TE/(AK6+U))
       C3 = C2/(GAPSF*C1)
       C4 = (AK6-1.)/L.- (C3+4K6) ++2
       C5=1.-2. #AK6+C3++2
       Co=C5++2+4.+C4+C3++2
       IF (C6)21,22,23
21
       CALL ERRCR
       AL TURN
       AM62G=-C5/ (2. #C4)
 22
       GO TO 74
 23
       AM62G=(59AT(Cb)-C5)/(2.+C4)
       IF (AMOLGOLE, L ) GU TO 21
 24
       AN 6G=SURT(AM626)
       V6 =AM6G + GS (
       HS CAL=H6-V6++2/(2.+G+A)
       DELHS=HSCAL-HS6
       IF (ABS(DELHS) .I.E. 0. JJU5+HSCAL) GO TO 26
2:
       TS6=156+321HS/076
       GO TO 21
 26
       IF (IGASMX.CT.ux A6G=A25+A55
       C7=SQRT(1.+(AK6-1.)+AM62G/2.)
       FSG=C2/(CAFSF+A6G+AN6G+C7)
       FUMPS6*EXP ((PHI6-PHIS6)/REX6)
       CALL THERMO(P6, H6, T6, S6, XX1, 1, FARE, C)
       S6 AVE=(1624+S25+NG55+S55)/NG6
       IF (S6.GE.SEAVE: CO TO 27
       S6=S6AVE
      P6=EXP(AMX + (FHI6-S6)/1.986375)
 27
       IF (IGASNX.EG.1) GO TO 35
       IF (IDES. EG. 6) GC iO au
C *** CALCULATE AE AS A FUNCTION OF INFUT AND
       TS 6= T6/(1. L+(((AKL-1.0)/2.0) + AME + +2.))
      CO 28 JJ=1,15
      in LL FROJOP (FARE, 12., CSG, AKE, CFG, FEX6, PHIS6, HS6)
       V6=AM6+CSa
      HSCAL=H6-V6++:./1:.+G+AJ)
      OELHS=noCAL-ray
      if thostuelresoles outsynscals Gu TO 2
 25
       156=156+UELHS/LH
      GO TC 25
 29
      PS6=F6/((1.0+(((AK6-1.4)/2.0)+AK6++2.))++(AK6/(AK6-1.0)),
      AM6DS=AM6
      KHO=CAPSF#FJG/(AJ#KEXO#TS6)
      A6 = #G6/(k +u + v ±)
      WRITE(6,234) AE
 200
      FURMAT(IHe,
                      SIMAFIEK SUHNER ENTHANCE DESIGN AREA A6
                                                                  ,F8.3)
      GO TO 36
C *** CALCULATES AM6=F (A6UESIGN)
      TS6P=TE/(1.0+((\AK6-1.0)/2.0)+AM6CS++2.))
```

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00 32 I=1,15
     CALL PROCOM (FAR6, TS6P, CS6, AK6, CP6, REX6, PHIS6, HS6)
     PS 6P=PS6+(TS6P/TS6)++(AK6/(AK6-1.0))
     RHO=CAPSF+FS6P/(AJ+REX6+TS6P)
     IF (H6.GT.HS6) G0 T0 31
     HR ITE (8, 201) P6, PS6P, T6, TS6P
     FORMATIZONOSORT OF H6-HS6 NEG .6E15.6.6H$$$$$$)
201
     CALL ERROR
31
     V6=SQRT (2. *G*AJ* (H6-HS6))
     A6 P= WG6/ (RHO*V6)
     DE LAG = AGP - AG
     V6=HG6/(RH0+A6)
     AM 6= V6/CS6
     AH 62 = AH6 + + 2.
     IF (A8S(DELA6).LE.0.002*AF)
                                      GO TO 33
32
     TS6P=T6/(1.0+(((AK6-1.0)/2.0)*AH62))
     GO TO 21
33
     TS6=TS6P
     PS6=PS6P
     GO TO 36
34
     16=155
     P6=P55
     H6 = H55
     S6=S55
     HG 6= H G55
     PS6=PS55
     V6=V55
     AH 6 = A M55
     IF (IGASMX.EQ.0) A6=A55
     GO TO 36
35
     AM 62 = AM 62G
     AM 6= A M6G
     A6 = A 25+A 55
36
     CALL COAFBN
     RETURN
     END
```

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```
SUPROUTINE COAFEN
       COMMON /
                   ALL/
                                      , MODE
             , IDES ,JOES
                              , KDES
                                             , INIT
                                                       , IDUMP , IANTP ,
                                              , IDSHOC, IHSHOC, NOZFLT.
     2 IGASHX, ICBURN, IAFTBN, IDCD , IMCD
     3 ITRYS, LOOPER, NOMAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
       COMMON/DESIGN/
      1PCNFGU ,PCNIGU ,PCNCGU ,T4GU
                                           ,DUMD1
                                                                       , DELSFC
                                                     ,DELFG
                                                              , DELFN
                                  , ETAFOS
                                                              , ETAFCF
     2 ZF DS
               , PCNFDS , PRFDS
                                           , WAFDS
                                                    .PRFCF
                                                                       , WAFCF
                                  ,ETAIDS
                                           , WAIDS
                                                              , ETAICF , WAICF
     3 ZI OS
               ,PCNICS ,PRI()
                                                     ,PRICF
     4 ZC DS
                                                    ,PRCCF
               ,PCNCDS ,PRCDS
                                 , ETACDS , HACDS
                                                              , ETACCF , WACCF
     5 T4 DS
               , WFBOS
                        ,DTCODS ,ETABOS , MAJCDS ,DPCODS ,DTCOCF ,ETABCF
     6TFHPDS , CNHPDS , ETHPDS , TFHPCF , CNHPCF
                                                    ,ETHPCF
                                                             , DHHPCF , T2DS
     7TFIPOS , CNIPCS , ETIPOS , TFIPCF
                                           ,CNIPCF
                                                    ,ETIPCF
                                                             ,DHIPGF
                                                                      ,72105
     STFLPDS . CNLPDS
                        ,ETLPOS ,TFLPCF
                                           , CNLPCF
                                                    ,ETLPCF
                                                             ,DHLPCF ,T22DS
                        ,DTOUDS ,ETADOS , NA23DS ,DPDUDS
                                                                      , ETADCF
     9124DS
               , WFDDS
                                                             , DTDUCF
     AT7 DS
               , WF ADS
                        , OTAFOS , ETAAOS , NG&COS , OPAFOS , OTAFCF , ETAACF
                                 , A7
                                           , 48
               , A25
                                                    , 19
     8 A5 5
                        , A6
                                                              , A26
                                                                       , A29
     C PS 55
               , AH55
                        ,CVDNOZ ,CVNNOZ ,A8SAV
                                                    ,A9SAV
                                                              ,A26SAV ,A29SAV
       COMMON /
                  EACK/
              ,P55
                      ,H55
     1 T55
                              ,S55
                                       ,T25
                                               , P25
                                                       ,H25
                                                               ,525
                             ,WFD
              , HG55
                                      , HG24
     2 HFB
                                               ,FAR24 ,P1
                      FAR55
                                                               , DUNB
              , P6
                                               , P7
     3 T6
                      ,H6
                               36
                                       ,17
                                                       ,H7
                                                               ,57
                                              , P9
              ,P8
                              58
                                                       ,H9
                      ,H8
                                      ,T9
                                                               ,59
     4 T8
              , HFA
                      ,WG7
                              FAR7
                                               , DPAFT
                                                       , 455
     5 kG 6
                                       , ETAA
                                                               , V25
                      ,AM6
                                              , Y7
     6 FS 6
              .V6
                              TS7
                                       PS7
                                                       , AM7
                                                               , AH25
     7 TS 8
              ,PS8
                      , V 8
                                      ,TS9
                                              ,PS9
                                                       , V 3
                                                               , AH9
                              ,AM8
              , FRD
                      . VJD
                              ,FGHD
                                      , VJH
                                              , FGMM
                                                       ,FGPD
     8 VA
                                                               ,FGPH
     9 FG M
              ,FGP
                      , HFT
                              , WGT
                                       ,FART
                                              , FG
                                                       ,FN
                                                               ,SFC
       DIMENSION C(9)
       DATA AWORD/6HCOAFBN/
       WORD = AWORD
       G(2) = 0.
       Q(3) = 0.
       AJ=778.26
       CAPSF=2116.2170
       G= 32.174049
       WF6=WF8
       IF (IGASMX.GT.O) WF6=WF6+WFD
       MA6=WG6-WFE
       CRY LOSS
       HG 6C=NG6+SCR1 (T6)/P6
2
       IF (IDES.EQ.1) WG6CDS=WG6C
       DPAFT=DPAFDS+(WG6C/WG6CDS)
       IF (DPAFT.GT.1.) DPAFT=1.
       P7 = P6 + (1. - DPAFT)
       A7 = A6
       FAR6=WF6/WAE
       CALL FROCOM(FAR6, T6, XX1, XX2, XX3, XX4, PHI6, XX6)
       WQ A= WG6/A7
       C1=P7+SQRT (G/(T6+AJ))+CAPSF
       AM 7 = A M 6
       TS7=0.875*T6
       00 22 I=1,15
20
       CALL PROCOM(FAR6, TS7, CS7, AK7, CP7, REX7, PHIS7, KS7)
       V7 = AH7+CS7
```

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HSCAL=H6-V7++2/(2.+G+AJ)
      DELHS=HSCAL-HS7
      IF (ABS(CELHS).LE.O. 0005*HSCAL) GC TO 24
22
      TS 7=TS7+DELHS/CF7
      GO TO 8
24
      HQ AT=C1+SQRT (AK7/REX7) +AH7/(1.+(AK7-1.) +AH7++2/2.)++
     1 {{ AK7+1.}/ (2.+(AK7-1.); }
      DIR=HOA/NO AT
      EH = (HQA-HQAT)/NQA
      CALL AFQUIR(C(1).AM7,EW.0.,30..0.0005,DIR.AM7T,IGO)
      60 TO (26,28,8),IGO
26
      AM 7 = A M7T
      IF (AM7.GE. 1.0) AM7=0.9
      GO TO 20
28
      PS7=P7/EXP((PHI6-PHIST)/REXT)
      IF (IAFTBN. GT. 0) GO TO 4
C *** NON-AFTERBURNING
3
      17=16
      WF A= 0 . 0
      FAR7=FAR6
      MG 7 = H G6
      GO TO 13
      AFTEREURNING
      IF (IAFTBN. 10.2) T7=T6+2000.
      IF (T7.LE.T5) GO TO 3
      RHO65=CAPSF*FS7/(AJ*REX7*TS7)
      PS 65 = PS7
      V65= V7
      0(2)=0.
      Q(3) = 0.
      IF (T7.GT.4000.) T7=4000.
 *** IF DESIRED, ENTER CALCULATIONS FOR ETAA HERE
      HV=(((((--4594317E-19+T7)--2034116E-15)+T7+-2783643E-11)+T7
     1+.2051501E-07)*T7-.2453116E-03)*T7-.9433296E-01)*T7+.1845537E+05
      CALL THERMC(F7, HA, T7, XX1, XX2, 0, 0.0, 0)
      FAR7 = (HA-H6) / (HY*ET AA)
       IF (FAR7.GT.O.) GO TO 6
      17 = T6
      GO TO 5
      WFAX=FAR7# NG6
      IF (IAFTBN. EQ. 1) GO TO 9
      ERRH= (WFA+WFAX) /KFA
      DIR=SORT (WFA/WFAX)
      CALL AFOUIR (C(1), T7, ERRH, 0., 26., 0.0001, DIR, T7T, IGO)
      GO TO (7,10,8), IGO
      17=171
      GO TO 5
      CALL ERROR
8
9
      WF A= HFAX
10
      FAR7= (WF6+WFA)/WA6
      HG7=HG6+HFA
 *** MOMENTUP LCSS
      CALL FROCOF (FAR7, T7, XX1, XX2, XX3, REX7, PHI7, H7)
      RHO7=CAPSF*P7/(AJ*REX7*T7)
      V7=HG7/(RHC7+A7)
```

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Q(2) = 0.Q(3) =0. FS7=PS65-0.01 RH 07=HG7/(V7\*A7) 11 HS7=H7-V7\*\*2/(2.\*G\*AJ) CALL THERMO11.0, HS7, TS7, PHIS7, XX2,1, FAR7,1) IF (TS7.GE:301.) GO TO 110 CALL THERMC(1.0, HS7, 400., PHIS7, XX2, 1, FAR7, 0) V7=SQRT(2.+G+AJ+(H7-HS7)) GO TO 11 110 PS7=RHO7\*AJ\*REX7\*TS7/CAPSF PS7A=PS65+(RH065+V65++2-RH07+V7++2)/(L PSF) GIR=SQRT (ABS (PS7/PS7A)) EP=(PS7-PS7A)/PS7 CALL AFQUIR(@(1), V7, EP, 0., 50., 0.0005, DIR, V7T, IGO) **V7=V7T** IF (V7.LT.100.) Y7=100. GO TO (11,12,8),IGO P7=PS7\*EXP((PHI7-PHIS7)/REX7) 12 CALL FROCOM(FAR7, TS7, CS7, XX2, XX3, XX4, XX5, XX6) AM7= V7/CS7 CALL THERMO(P7, H7, T7, S7, XX2, 1, FAR7, 0) 13 IF(IDES.EQ.1) WRITE(6,100) WG6CDS 100 FORMAT(19HOAFTERBURNER DESIGN, 5x8H WG6CDS=.E15.8) CALL COMNOZ RETURN

END

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```
SUBROUTINE COMNOZ
 COMMON /
              AI.L/
       , IDES
                       ,KDES
                               ,HODE ,INIT ,IDUMP ,IAMTP ,
                JOES.
2 IG AS MY, I OBURN, IAFTBN, IDCD , IMCD , IDSHOC, IMSHOC, NOZFLT.
3 IT RYS, LOOPER, NOMAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
 COMPAN/DESIGN/
1PCNEGU , PCNISU , PCNGGU , T4GU
                                     , DLMD1
                                               ,DELFG
                                                        , DELFN
                                                                 ,DELSFC ,
         , PONFOS , PRFOS
                            , ETAFOS , HAFOS
                                               .PRFCF
2 ZF DS
                                                        , EYAFCF
                                                                 . WAFCF
                                               ,PRICF
                                                        , ETAICF , WATCF
3 2 X US
         , PANIOS , PRIDS
                            , ETAIDS , WAIDS
         , PONCOS , PRODS
                                               ,PRCCF
4 2C 9S
                            ETACOS , HACOS
                                                        ,ETACCF , HACCF
         , WEEDS
                  DTCODS , ETABOS , NASCOS , OPCODS , DTCOCF , ETABCF
5 14 DS
STEHPOS , GNHPOS , ETHPOS , TEHPOF , CNHPCF , ETHPOF , DHHPCF , T20S
7 TF IPOS , CRISCS , ETIPOS , SFIPCF , CRIPCF , ETIPCF , DHIPCF , T210S
8 TFEPOS , CNLFGS , ETLPOS , TFLFGF , CNLPCF , ETLPCF , DHLPCF , T22DS
                   ,OTOUDS , ETADOS , WAZZOS , OFDUDS , DTDUCF , ETADOF
         , WF CUS
9 T2 40S
                   ,UTAFOS ,ETAADS ,NG6CDS ,DPAFDS ,DTAFCF
                                                                 PETAACE
AT7 DS
         , HF ADS
                            9 AT
                                     , A 8
                                               ,49
                                                                 ,A29
B 455
         , 425
                                                        , 428
                   , A6
         , AH 55
                   ,CVDNOT ,CVHNOZ ,AESAV
CPS 55
                                               ,A9SAV
                                                        , AZBSAV , AZBSAV
             EACK/
 COMMON /
        ,P55
                                 ,T25
1155
                ,H55
                        ,$55
                                         ,P25
                                                 ,H25
                                                         ,525
2 W B
        , WG55
                FARSS , HFD
                                 , WG24
                                         ,FAR24 ,P1
                                                         , DUMB
                        ,56
                                 ,17
                                         ,P7
                ,H6
                                                 ,H7
316
        , P6
                                                         ,57
                                 ,19
418
        , P &
                                         , P9
                                                 , H9
                ,H8
                         ,58
                                                         ,59
        , PFA
                , WG7
                        9FAR7
                                 , ETAA
                                         , DPAFT
                                                 , V55
5 hG6
                                                         , V25
                ,AH6
                                 ,PS7
                                         , Y7
                                                 ,AH7
6 FS 6
        , V6
                         TS7
                                                         ,AH25
                , V 8
                        ,AH8
                                 ,TS9
                                        ,P$9
                                                 , 49
7 TS 8
        ,258
                                                         ,AM9
        , FRO
                                 , VJM
                                         , FGHH
                , VJD
                         ,FGMD
                                                 , FGPD
8 VA
                                                         ,FGPH
                        , WGT
9 FG M
        *FGP
                ,HFT
                                 .FART
                                         , FG
                                                 .FN
                                                         ,SFC
 DATA ANDRO/6HMNOZZL/
 NORD=AWORD
 ABSAV=A8
 ASSAV=AS
 NO 2M=0
 IMNOZ=0
 IF (NOZFLT.EQ.1.08.NOZFLT.EQ.3) NOZM=1
 IF (ICES.EQ.1.OR.IAFTBN.GT.O.OR.NOZM.EQ.1) IMNOZ=1
 IF (IMCD.EQ.1) GO TO 1
 CALL CONVRG(T7, H7, P7, S7, FAR7, NG7, F1, INNOZ, A6,
178, H8, P8, S6, TS8, PS8, V8, AM8, ICON)
 GO TO (3,3,3,2), ICON
 CALL CONDIVITY, H7, P7, S7, FAR7, HG7, F1, IHNOZ, A8, A9, P7R,
118,H8,P8,S8,T9,H9,P9,S9,TS8,TS9,PS8,PS9,V8,V9.AM8.AM9.ICON)
 IMSHOC=ICON
 GO TO (4,4,4,2), ICON
 CALL ERROR
 19 = T 8
 H9 = H8
 F9=P8
 S9=S5
 159=158
 PS 9= PS8
 V9=V8
 84A=PHA
 49=A8
 IMSHOC=ICON+3
```

ERR(6)=(P7R-F7)/F7R
IF(IMAOZ.EQ.1) HRITE(6,1Q0) A8,AM8,A9,AM9

100 FORMAT(14H0NCZZLE DESIGN,1GX8H A8=,E15.0,8H AM8=,E15.8,
16H A9=,E15.8,8H AM9=,E15.8)
RETURN
END

```
SUBROUTINE PERF
 COMMON /
                                 , MODE
                        , KDES
1 MO RO
       , IDES , JOES
                                          , INIT , IDUPP , TANTP ,
2 IGASHX, I DBURN, IAFTBN, IDCD , IMCD , IDSHOC, IMSHOC, NOZFLT,
3 IT RYS, LOGPER, NGHAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
 COMMON/DESIGN/
                                      , OLMD1
                                                ,DELFG
1PCNFGU , PCNIGU , PCNCGU , T4GU
                                                         , DELFN
                                                                   , DELSFC ,
                                               ,PRFCF
                                                         , ETAFCF , HAFCF
         ,PCNFDS ,PRFOS
                            , ETAFOS , WAFDS
         .PCNICS ,PRIOS
                            ,ETAIDS , WAIDS
                                               ,PRICF
                                                         , ETAICF , WAICF
                                                ,PRCCF
                                                         ,ETACCF ,WACCF
         , PCNCOS , FRCDS
                            , ETACOS , WACOS
4 ZC US
         , WF EDS
                   ,OTCODS ,ETABOS , WAZCOS , DPCODS , DTCOCF , ETABCF
5 T4 DS
STEHPOS , CHAPCS , ETHPOS , TEHPOF , CHAPCE , ETHPOF , DHAPCE , T2DS
                                               ,ET IPCF
                                                         ,DHIFCF
7 YFIPOS , CNIPCS , ETIPOS , TFIPCF
                                      , CNIPCF
                                                                   ,TZ10S
ATFLPOS , GNLPOS , ETLPOS , TFLPCF
                                      ,CNLPCF ,ETLPCF ,DHLPCF ,T2205
912405
         , HFODS
                   ,DTDUOS ,ETADOS , NA23OS ,OPDUDS , DTOUCF ,ETADCF
A 17 0S
         . HF ADS
                   DTAFUS , ETAADS , NGCODS , DPAFDS , OTAFCF , ETAACF
                   , A6
                            5 A 7
                                      5A,
                                                ,A9
                                                         ,A28
                                                                   , A29
8 A55
         ,A25
         , AH 55
                   ,CVDNOZ ,CVNNOZ ,A8SAV
CPS 55
                                                , A3SAV
                                                         ,AZ8SAV ,AZ9SAV
 COMMONA FRONTA
                                                ,P2
                                                          , H2
1 T1
         , P1
                   · Hi
                             , $1
                                      ,T2
                                                                   , S2
         ,P21
                             , $21
                                      .122
                                                          ,H22
                                                                   ,522
2 T2 1
                   , H21
                                                .P22
         ,P3
                                                          ,H4
                   ,H3
                                      ,T4
3 13
                                                ,P4
                             , $3
                                                                   ,54
                                                P5
                                                          , H5
         ,P45
                             ,545
                                      ,T5
                                                                   ,55
4145
                   , H45
         ,P55
5155
                   ,H55
                             ,$55
                                      ,BLF
                                                , BLI
                                                         ,BLC
                                                                   , SLOU
                             , WAFC
                                      , HAF
                                                ,BLDUI
                                                          , BLOUC
                                                                   , BLOB
6 CN F
         , FRF
                   , ETAF
7 CN I
         , PRI
                             , WAIC
                                      , WAI
                                                ,BLOBI
                                                          ,BLOSC
                                                                   EAH,
                   ,ETAI
                   ,ETAC
                                      , HAC
                                                          , DPCCH
8 CNC
         ,PRC
                             , NACC
                                                , ETAB
                                                                   , WG4
         , ET ATHS
                                      , BLHP
                                                ,BLHFI
                                                          ,BLHFC
                                                                   ,FAR4
                   ,DHTCHP ,DHTC
9 CN HP
                                                ,BLIPI
                                                          , BLIPC
                                                                   , DUNF
         , ETATIP
A CN IP
                   ,OHTCIF ,OHT1
                                      ,BLIP
         , ETATLE , DHTCLP , DHTF
BCNLP
                                      , BLLP
                                                ,BLLPI
                                                          ,BLLPC
                                                                   ,CS
                   , HG5
                             ,FAR5
                                                          , HPEXT
C NG 45
         ,FAR45
                                      , NG55
                                                FAR55
                                                                   , AM
                   , ZF
                             , PCNF
                                                ,PCNI
                                                          , ZC
                                                                   , PCNC
                                      ,ZI
         , ET AR
DALTP
                   ,TFFIP
                                                          , PCBLC
                                                                   ,PCBLDUI,
          ,TFFHP
                             ,TFFLP
                                     ,PCBLF
                                                ,PCBLI
E NF 8
FPC3LDUC, PC8LC8I, PC8L08C, PC8LHFI, PC8LHPC, PC8LIPI, PC8LIPC, PC8LLPI,
 COMMON
            SIDE
1 XP1
         , XWAF
                             , XHAC
                                                ,X3LOU
                                                          ,XBLOUI ,XBLOUC
                   , XHAI
                                      , XELF
                             , XP21
                                                          DUMS1
                                                                   , DUMS 2
          .XH3
                   , XT21
                                      , XH21
                                                ,XS21
2 XH 22
3123
          ,723
                   ,H23
                             ,523
                                      ,T24
                                                ,P24
                                                          ,H24
                                                                   , S24
                                                ,P28
                             , $25
                                                          ,H28
                                                                   , S28
4125
          , P25
                   , H25
                                      ,T28
                             , 529
                                                ,DUNS4
                                                          , DUMS 5
                   ,H29
                                                                   -DUMS 6
                                       ,DUMS3
5 T2 9
          , 62 %
                             ,FAR24
                                      , ETAD
                                                          ,BYPASS ,DUNS7
          , HFC
                                                JUG90,
6 HAD
                   , #G24
          , PS 28,
                   , V28
                                                                   ,AM29
                             . AM28
                                      ,TS29
                                                .PS29
                                                          . 489
7 TS 24
            FACKI
 COMMON /
         , XP55
                                 , XT25
                                         , XP25
                                                           , XS25
X XT 55
                 ,XH55
                         ,XS55
                                                  , XH25
        , x HG 55 , X FAR55, XWFD
                                  ,XWG24 ,XFAR24,XXP1
                                                           , DUMB
XXMFR
        ,P6
                                  ,17
                                          , P7
                 ,H6
                         ,$6
                                                  ,H7
                                                           ,57
316
                                          , P9
                                                           ,59
         , F8
                 ,H8
                         ,58
                                  ,T9
                                                  , H9
4 TS
        , HFA
                                  ,ETAA
                 , HG7
                         ,FAR7
                                          DPAFT , V55
                                                           , V25
5 NG 6
        , 46
                                  ,PS7
                                          , ¥7
                                                  ,AH7
                                                           , AM25
6 PS 6
                 , AME
                         ,TS?
                                  ,TS9
                 , V 8
                         ,AHS
                                          ,PS9
                                                  , 79
        ,058
7 TS 8
                                                           , AMS
         ,FRD
                                  , VJH
                                                  , FGPD
                                                           , FGPH
                 QLV,
                                          , FGHH
                         ,FGHD
AV 6
                 , KFT
                         , WGT
                                          ,FG
9 FG M
        , F GP
                                  ,FART
                                                  , FN
                                                           ,SFC
                   FERF/
 DATA AWCRO/6H
 WORD = AHORD
```

en and had his hours and the statement of the statement o

G= 32.174049 CAPSF=2116,2170 WFT=WFB+HFQ+NFA HAT=HAF-BLOB HGT=WAT+WFT FART=HFT/HAT VA =AH+CS FRD=VA\*HAF /G VJM=CVMNOZ 4V9 FGMM=VJH+HG7/G FGPM=CAPSF + (PS9-P1) + R9 IF (IGASMX. GT . 8) GO TO 1 VJ D=CVDNGZ+V29 FGMD=VJD\*WG24/G FGPD=CAPSF \* (PS29-P1) \* A29 1 FGH=FGHH+FGHD FGP=FGPM+FGPD FG = FGP+FGP FN=FG-FRD SF C=3600.\* HFT/FN FG = DELFG F G FN=DELFN+FN SFC=DELSFC+SFC CALL CUTPUT CALL ERROR RETURN END

```
SUBROUTINE CCNOUT (ICON)
 CIMENSION WORDY (345), IOUT (150), AOUT (6), WOUT (6), PARA':1(96),
1 PARAM2(121), PARAM3 (56), PARAM4 (72)
 COMMON /
              ALL/
                                  , MODE
        ,IDES
                 ,JDES
                         ,KDES
                                           ,INIT ,IDUPP ,IANTP ,
1 HO RD
2 IG ASMX, YOBURN, IAFTBN, IDCO
                                 , IMCD
                                          , IDSHOC, IMSHOC, NOZFLT,
3 ITRYS, LOOPER, NOMAP, NUMMAP, MAPEDG, TOLALL, ERR(9)
 COMMON/DESIGN/
                                       , DUMD1
                                                 ,DELFG
                                                           ,DELFN
1PCNFGU , PCNIGU , PCNCGU , T4GU
                                                                     ,DELSFC ,
                                                 ,PRFCF
                                                           , ETAFCF
         , PCNFDS , PRFDS
                             , ETAFOS , WAFOS
                                                                    , WAFCF
                             ,ETAIDS
                                      , HAIDS
                                                           ,ETAICF
                                                                    , WAICF
          ,PCNICS ,PRIDS
                                                 PRICE
3 ZI OS
                                                 ,PRCCF
                                                           , ETACCF , HACCF
                                       , WACDS
4 ZC DS
          , PCNCDS , PRCDS
                             , ETACUS
                   , STCODS , ETABOS
                                       , MA3COS , UPCODS , OTCOCF , ETABGE
5140S
          , WFBDS
                                                           , DHHPCF
                                                 , ETHPCF
                                                                    ,T2DS
61FHPDS
         , CNHPOS , ETHPOS , TFHPCF
                                       ,CAHPCF
                                       ,CNIFCF
                                                ,ET IPCF
                                                          , DHIPCF
                                                                    ,T210S
7 TF IPOS
          , CNIPOS , ETIPOS , TFIPCF
                                       ,CNLPGF ,ETLPGF ,DHLPGF
                                                                    ,T220S
BIFLEOS , CNLPOS , ETLPOS , TFLPCF
                   , DTDUDS , ETADOS , WAZZOS , DPDUDS , DYDUCF , ETADOF
         , WF CDS
912405
                    ,OTAFUS ,ETAAOS , NGCODS ,DPAFDS ,DTAFCF ,ETAACF
          , WF ADS
ATT OS
          ,A25
                   , A6
                             , A7
                                                 ,A9
                                                           , A28
                                                                     ,A29
B 455
                                       , A8
          , AH 55
                    ,CVDNOZ ,CVMNOZ ,A8SAV
                                                 ,A9SAV
                                                           ,A28SAV ,A29SAV
CPS 55
 COMMON/ FRONT/
                             ,51
          , P1
                    , H1
                                       ,TE
                                                 ,P2
                                                           , H2
                                                                     ,52
1 T1
                             ,521
                                       ,T22
                                                 .P22
                                                           ,H22
                                                                     ,S22
2 12 1
          , P21
                    ,H21
                                       ,T4
                                                           , H4
                                                                     , S4
          , P3
                                                 ,P4
373
                    , H3
                             , 53
          ,P45
                                       ,T5
                                                 ,05
                                                                     ,55
4T45
                    , 445
                             ,545
                                                           , H5
                             , $55
          , 555
                    . H55
                                       , BLF
                                                 ,BLI
                                                           , BLC
                                                                     , BLDU
5 15 5
6CNF
          , PRF
                             , WAFC
                                       , HAF
                                                 ,SLDUI
                                                           , BLDUC
                                                                     38L08
                    ,ETAF
                                                           ,BLOBC
                                       , WAI
                                                 BLOBI
                                                                     , WA3
7 CN I
          , PRI
                    , ETAI
                             , HAIC
                    ,ETAC
                              , WASC
                                                           , DPCOM
8 CN C
          , PRC
                                       , HAC
                                                 ,EIAB
                                                                     , WG4
                    , DHT CHP
                             , OHTC
                                       , BLKP
                                                 ,BLHPI
                                                           .BLHPC
                                                                     ,FAR4
9 CN HP
          , ET AT HP
                                                 ,BLIPI
                                                           , BLIPC
ACNIP
                    , DHTCIP
                                       ,BLIP
                                                                     , DUMF
          , ETATIP
                             , DHTI
                                                                     • CS
                   , GHTCLP
                             , DHTF
                                                 ,BLLPI
                                                           , BLLPC
          , ETATLP
                                       ,BLLP
BCNLP
                    , KG5
                              ,FAR5
C WG 45
          ,FAR45
                                       .WG55
                                                  FAR55
                                                           , HPEXT
                                                                     ρAΜ
                                                 ,PCNI
                                                           , ZC
                                                                     , PCNC
DALTP
          , ETAR
                    , ZF
                             , PCNF
                                       ,21
                             , TFFLP
                                                 ,PCBLI
                                                           , PCBLC
                                                                     ,PC8LC
                    , TFF IP
                                       ,PCBLF
EW B
          , TF FHP
FACELOUG, POELCEI, POBLOBO, POBLHPI, POBLHPO, POBLIPI, POBLIPO, POBLLE.
GPF BLLPC
 COMMONY
            SIDE/
                                        , XELF
                                                  ,XBLDU
                                                           ,XBLOUI ,MBLOUC
          , XHAF
                    , XHAI
                              , XHAC
1 XY 1
                                                                     , DUNS 2
                              , XP21
2 XH 22
          SHX,
                    , XT21
                                       , XH21
                                                  ,XS21
                                                           , DUMS1
                              ,523
                                                                     ,524
31:3
          , P23
                    , H23
                                       , 724
                                                 ,P24
                                                           ,H24
                                                  ,P28
4115
                              ,S25
                                       ,T28
                                                                     ,528
          , F25
                                                           ,H28
                    ,H25
                                                 , DUMS4
                                                           , DUMS5
                                                                     . DUNS 6
          , P29
                              , $29
                                        , CLHS3
5139
                    ,H29
                              ,FAR24
                                                           ,BYPASS ,DUMS?
          , WF C
                    , NG24
                                       ,ETAD
                                                  , OPDUC
64-C
          ,FS28
                    , V28
                              , AM28
71.28
                                        ,TS29
                                                  ,PS29
                                                           , V29
                                                                     ,AM29
             BACK/
 C MMON /
                          ,XS55
         , XP55
                 ,XH55
                                   ,XT25
                                           , XP25
                                                    , XH25
X X 7 55
                                                            , XS25
                 ,XFAR55,XNFO
                                   ,XHG24 ,XFAR24,XXP1
                                                            , DUMB
X XNFB
         , X HG 55
                                   , T7
315
         ,P6
                 ,H6
                          ,56
                                           ,P7
                                                    , H7
                                                            ,57
                                           , 29
                                                            ,59
         , F8
                 3H,
                          ,58
                                   ,T9
                                                    ,H9
4 TB
                                   , ETAA
                                           , DPAFT , V55
                                                            , V25
         , WFA
                 , HG7
                          ,FAR7
5 HG 8
                 ,AM6
                                           , V7
                                                    ,AH7
                          ,TS7
                                   ,PS7
                                                            , AM25
6 P° 6
         , V6
         ,PS8
                 , V 8
                                   ,TS9
                          ,AH8
                                           ,PS9
                                                    , V9
                                                            , AM9
7T38
                                                    ,FGPD
         , FRD
                                           , FGMN
                                                            , CGPH
                                   , VJM
AV 8
                  ,VJD
                          ,FGHD
                  , WET
                          , WGT
                                   ,FART
                                           , FG
                                                    ,FN
                                                            ,SFC
9FAM
         , F GP
```

,这种是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我 第一个人,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是一种,我们是

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Year Annual Control

```
EQUIVALENCE (PARAMi (1), PONFGU), (PARAM2(1), T1), (PARAM3(1), XP1),
1 (PARAM4(1), XT55)
 DATA (WORDY(I), I=1, 96)/
17HPCNFGU , 7HPCNIGU , 7HPCNCGU , 7HI4GU
                                             ,7HDUM91
                                                         ,7HBELFG
                                  ,7HPCNFOS ,7HPRFOS
2 TH DELFN
           , THDELSFC , THZFDS
                                                         ,7HETAFDS
                       , THE TAFOF
                                              ,7HZIDS
                                                         ,7HPCNIDS
37H WAF BS
           , 7HPRFCF
                                  .7HHAFCF
                      ,7HWAIOS
                                             , THE TAICF
                                  ,7HPRICF
47HPRIDS
           . THETAIQS
                                                         ,7HHAIGF
57HZCDS
           , THECHODS
                       ,7HPRCBS
                                  , THETACOS , THEACOS
                                                         y 7 HPRCCF
           . 7H & ACCF
                                             ,7HDTCCDS ,7HETABDS
67HETACCF
                       ,7H74DS
                                  ,7HHFBDS
                                             ,7HTFHPDS
77HWA3COS , THOPCOOS , THOTCOCF , THETABCF
                                                        ,7HCNHPDS
87HETHFDS , 7HTFHPCF
                       ,7HCNHPCF
                                  , THE THPCF
                                             ,7HDHH#CF
                                                         ,7HT2DS
97HTFIPGS
           . 7HCNIPOS
                       , THETIPUS
                                  ,7HTFIPCF
                                             ,7HCNIPCF
                                                         ,7HETIPCF
                       ,7HTFLPOS
17HDHIPCF
           ,7H7210S
                                  ,7HCNLPDS
                                             ,THETLPDS
                                                         47HTFLPCF
           , THETLECF
                       , THUHLPCF
                                                         ,7HWFODS
27HCNLPCF
                                  ,7HT220S
                                             ,7HT 240S
STHOTOUDS , THETADOS , THWA 230S
                                 ,7HDFDUDS ,7HDTDUCF
                                                        ,7HETADOF
           , THWFADS
                       . THUT AFDS
47HT70S
                                 , THETAADS , THWG6CDS , THUPAFDS
                                  ,7HA25
                                             ,7HA6
                                                         ,7HA7
57HDTAFCF . THETAACF . THASS
           ,7HA9
                       ,7HA28
                                             ,7HPS55
                                                         ,7HAH55
67HA8
                                  ,7HA29
77HCVBNOZ , 7HCVHNOZ , 7HA8SAV
                                  , THASSAV
                                                         ,7HA29SAV
                                              ,7HA28SAV
 DATA (WORDY(I), I=97,150)/
           ,7HPi
                       ,7HH1
                                  ,7HS1
                                             ,7HT2
                                                         ,7HP2
17HT1
           ,7HS2
                       ,7HT21
                                  ,7HP21
27HH2
                                             ,7HH21
                                                         ,7HS21
37HT22
           ,7HF22
                       ,7HH22
                                  ,7HS 22
                                             ,7HT3
                                                         ,7HP3
47HH3
           .7HS3
                       ,7KT4
                                  .7HP4
                                             ,7HH4
                                                         ,7HS4
           , PHF 45
                                             ,7HT5
                                                         ,7HP5
57HT45
                       ,7HH45
                                  .7HS45
                                             ,7HH55
67HH5
           ,7HS5
                       ,7HT55
                                  ,7HP55
                                                         ,7HS55
77HBLF
           , 7HBLI
                       ,7HBLC
                                  ,7HBLDU
                                             ,7HCNF
                                                         .7HPRF
                                  ,7HBLDUI
                                             , THBL DUC
                                                         ,7HBLOB
87HETAF
           , THEAFC
                       ,7HWAF
           ,7HPRI
                                             ,7HWAI
97HCNI
                       , THETAI
                                  , THRAIC
                                                         ,7HBLOBI
 DATA (WORDY(I), I=151,217)/
                       ,7HCNC
                                  ,7HPRC
                                             , THE TAC
                                                         , THNACC
17HBLOEC
           , 7HHA3
27HWAC
                       ,7HDPCOM
                                  , 7HHG4
           , THE TAB
                                              .7HCNHP
                                                         , ?HETATHP
37HDHTCHP
           ,7HCHTC
                       ,7HBLHP
                                  ,7HBLHPI
                                              ,7HBLHFC
                                                         ,7HFAR4
47HCNIP
           ,7HETATIF
                      ,7HDHTCIP
                                  ,7HBHTI
                                             ,7HBLIF
                                                         ,7HBLIPI
                       ,7HCNLP
                                  - THE TATLP
                                             ,7HDHTCLP
57HBLTPC
           . THCUMF
                                                         .7HDHTF
                       , THELLPC
                                                         ,7HFAR45
67HBLLP
           , THELLPI
                                  ,7HCS
                                              ,7HWG45
77H WG5
           ,7HFAR5
                       ,7HHG55
                                             ,7HHPEXT
                                  . THE ARSS
                                                         ,7HAM
87HALTP
                       ,7HZF
           ,7HETAR
                                  . 7HP CMF
                                             .7HZI
                                                         .7KPCNI
                                              ,7HTFFIP
97H ZC
           , THEGNO
                       ,7HWF8
                                  . 7HTFFHP
                                                         ,7HTFFLP
                       ,7HPCBLC
17HPCBLF
           . 7HFCBLI
                                  ,7HPCBLOUI,7HPCBLOUC,7HPCBLOBI,
27HPCBLOBC, 7HPCBLHPI, 7HPCBLHPC, 7HPCBLIPI, 7HPCBLIPC, 7HPCBLLPI,
37HPCBLLPC/
 DATA (WORDY(I), I=218,273)/
           , THXWAF
                       ,7HXHAL
17H XP1
                                  ,7HXWAC
                                             ,7HXBLF
                                                         ,7HXBLDU
27HXBLOUI ,7HXBLOUC ,7HXH22
                                  ,7HXH3
                                             ,7HXT21
                                                         ,7HXP21
           ,7HXS21
                       ,7HGUNS1
                                  ,7HDLMS2
                                             ,7HT23
                                                         ,7HP23
37HXH21
47HH23
           ,7HS23
                                             ,7HH24
                       ,7HT24
                                  ,7HF24
                                                         ,7HS24
57HT25
           ,7HP25
                                             ,7HT28
                                                         STHP28
                       ,7HH25
                                  ,7HS25
67HH28
           ,7HS28
                                             ,7HH29
                                                         ,7HS29
                       ,7HT29
                                  ,7hF 29
77HOUNS3
           .7HCUMS4
                       ,7HQUMS5
                                  ,7HDUMS6
                                              ,7HHAU
                                                         s 7 HWFD
                       , THE TAD
                                  ,7HOPDUC
                                             ,7HBYPASS
87H WG 24
                                                         ,7HDUHS7
           97HFAR24
97HTS28
                       ,7HV28
           ,7HPS28
                                  ,7HAH28
                                              ,7HTS29
                                                         ,7HPS29
£7HV29
           . 7HAM29
 GATA (NORDY(I), T=274,345)/
17HX755
           . 7HXF55
                       ,7HXH55
                                  ,7HXS55
                                              ,7HXT25
                                                         ,7KXP25
```

```
,7HYHF8
                                                   ,7HXFAR55 ,7HXWFD
                                       ,7HX%G55
                ,7HXS25
     27HXH25
                                       ,7HDLMB
                                                              ,7HP6
                ,7HXFAR24 ,7HXXP1
                                                  ,7HT6
     37HXWG24
                                       ,7HP7
                                                   ,7HH7
                            ,7HT7
                                                              ,7FS7
                ,7HS6
     4 7446
                                                  ,7HT9
                                                              ,7HP9
                ,7HF8
                                       ,7HS8
     57H 13
                            7HH8
                            ,7HWG6
                                                              ,7HFAR7
                ,7HS9
                                       ,7HWFA
                                                  ,7HWG7
     6-443
                                       ,7HV25
                                                  ,7HPS6
                                                              ,7HV6
                , THEPAFT
                            ,7HV55
     7 THETAA
                                                              ,7HAM25
                            ,7HPS7
                                                   ,7HAM7
                ,7HTS7
                                       ,7HV7
     87HA46
                            97HV8
                ,7HFS8
                                       ,7HAM8
                                                   ,7HTS9
                                                              ,7HPS9
     97HTS8
                                       ,7HFRD
                            ,7HVA
                                                   ,7HVJD
                                                              ,7HFGMD
                ,7HAM9
     17HV9
                                                   ,7HFGM
                                                              ,7HFGP
                                       ,7HFGPH
                ,7HFGMM
                            ,7HFGPO
     2 74 JJH
                                                   ,7HFN
                                                              ,7HSFC
                ,7HWGT
                            ,7HFART
                                       ,7HFG
     37HHFT
                                                      ,345/
      DATA THEEND, BLANK, LIMIT//HTHEEND , 7H
      00 TO (1,12), ICCN
      INPUT SECTION
      50 4 N=1,150
      NUM=N
      KE AD (5, 100) AIN, CHANGE
      IF (AIN.EG. THEEND ) GO TO 5
      00 2 J=1,LIMIT
      J=J
      IF (AIN.EQ. HORDY (J)) GO TO 3
      CONTINUE
2
      KRITE (6, 101) AIN
      60 TO 4
3
      LL = (KUA) TUUI
       IF (CHANGE . NE. BLANK) WORDY (JJ) = CHANGE
      CONTINUE
      HRITE (6, 102)
5
      MUM=NUM-1
      RETURN
C *** CUTPUT SECTION
      IF (NUM.EQ. 1) GO TO 16
12
      HUd =4
       J=6
       on 15 I=1, NUM, 6
       1F (N. GT. 6) GC TO 13
       . - N
       N= N-6
13
       TO 34 K=1, J
       t - ] + K-1
       " IOUT(L)
       FOUT (K) = HORDY (M)
       1F 1H.GT.96) GO TO 20
       *)UT (K) = PARAM1(P)
       60 10 14
       > (M.GT.217) GO TO 21
 20
       HN=H-96
       AOUT (K) = PARAM2 (MN)
       10 TO 14
       1F (M.Gi.273) GO TO 22
 21
       YN=M-217
       ACUT (K)=PARAP3(Ph)
       60 TO 14
 22
       MN= M-273
       ATTOTAL (K) = PARAM4 (NN)
```

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```
14 CONTINUE
      HRITE (6, 103) (HOUT(K), K=1,J)
      WRITE(6,104)(AOUT(K),K=1,J)
      IF (N.LE.O) GC TO 16
15
      CONTINUE
      RETURN
16
      FORMAT(A7,7X,A7)
 100
      FORMAT ('OH OTHE WORD , A7, 26H NOT FOUND IN COMMON ARRAY)
101
      FORMAT(22HOERROR IN CONOUT INPUT)
102
103
      FORMAT(1H ,25XA7,5(8XA7))
      FORMAT(1H ,20X6E15.6)
104
```

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```
SUBROUTINE ERROR
 DIMENSION TRASH1(96), TRASH2(121), TRASH3(56), TRASH4(72)
                 ,JDES
        ,IDES
                         , KDES
                                 , MODE
                                         , INIT , IDUMP , IAPTP
1 HO RO
                                 ,IMCO ,INSHOC, IMSHOC, NOZFLT,
2 1G ASMX, IDBURN, IAFTBN, IDCD
3 IT RYS, LOOPER, NOHAP, NUMMAP, MAPEDG, TOLALL, ERR (9)
 COMMON/DESIGN/
                                       ,DUMD1
1 PC NEGU , PC NIGU , PCNCGU , T4GU
                                                 ,DELFG
                                                          , DELFN
                                                                    , DELSFC
                                                 ,PRFCF
                             , ETAFDS , WAFDS
          ,PCNFDS ,PRFDS
2 2F 15
                                                           , ETAFCF
                                                                    , WAFCF
          , PCNIDS , PRIDS
                             , ETAIDS , HAIDS
                                                 ,PRICF
                                                          , ETAICF , WAICF
3 21 05
                             ,ETACDS ,WACDS
                                                 ,PRCCF
                                                          , ETACCF , WACCF
42005
          , PCNCDS , PRCDS
                                      , WA3COS . DPCODS , DTCCCF , ETABCF
          , WF BDS
                    ,DTCODS ,ETABDS
5 '47S
6 17 HPDS , CNHPDS , ETHPDS , TFHPCF
                                       ,CNHPCF ,ETHPCF ,DHHPCF ,T2DS
71F.º05 , CNIPDS , ETIPDS , TFIPCF
                                       , CNIPCF
                                                ,ET IPCF
                                                          , DHIPCF
                                                                    ,TZ1DS
BIFLEOS , CNLPCS , ETLPOS , TFLFCF
                                       ,CNLPCF
                                                ,ETLPCF , DHLPCF
                                                                    ,T22DS
          , WF DDS
                                      ,WAZ3DS
                                                 , DPDUDS , DTDUCF
912405
                    , OTOUDS , ETADOS
                                                                    , ETADCF
                   , DTAFDS , ETAADS , NG6CDS
          , HF ADS
                                                 ,DPAFDS ,DTAFCF
A1765
                                                                    , ETAACF
                                       , A 8
                                                 ,A9
                             , A7
                                                                    ,A29
B 455
          , A25
                    , A6
                                                          ,A28
          , AH55
                    ,CVDNOZ ,CVHNOZ ,A8SAV
                                                 ,A9SAV
CPS 55
                                                          VAZBSAV , AZBSAV
 CUMMON/ FRONT/
                                       ,T2
                                                 ,P2
111
          , F1
                    , H1
                             , S1
                                                           .H2
                                                                    .52
          ,P21
                    ,H21
                             , $21
                                                 ,P22
                                                           ,H22
2121
                                       ,T22
                                                                    , 522
          ,P3
                             , S3
                                       ,T4
                                                 ,P4
                    ,H3
313
                                                           , H4
                                                                    ,54
          , P45
                             ,S45
                                       ,T5
                                                 ,P5
4145
                    ,H45
                                                           , H5
                                                                    ,S5
          ,P55
                             , $55
                                       , BLF
                                                                    ,BLDU
5155
                    , H55
                                                 ,BLI
                                                           , BLC
          , PRF
                    . ETAF
                             , WAFC
                                       , WAF
                                                 ,BL DUI
                                                          , BLDUC
6 CN F
                                                                    ,BLOB
                             , WAIC
                                       , HAI
7 CN I
                    ,ETAI
                                                 ,BLOBI
                                                           , BLOBC
          , FRI
                                                                    ,WA3
                             , HACC
                                       , HAC
          , PRC
                    , ETAC
                                                 ,ETAB
8 CN C
                                                          , DPCOM
                                                                    , WG4
                    , DHT CHP
          , ET ATHP
                                                 ,BLHPI
9C.HP
                             . OHTC
                                       , BLHP
                                                           , BLHPC
                                                                    .FAR4
                             , DHTI
                    , DHTCIP
ACVIP
          , ETATIP
                                       ,BLIP
                                                 ,BLIPI
                                                           , BLIPC
                                                                    , DUMF
                    , DHT CLP
                             , DHTF
                                       , BLLP
BCNLP
          , ETATLP
                                                 ,BLLPI
                                                           , BLLPC
                                                                    , CS
                    , HG5
                             ,FAR5
C No 45
          ,FAR45
                                       , WG55
                                                 FAR55
                                                          , HPEXT
                                                                    , AH
                             , PCNF
                                                 ,PCNI
                                                                    , PCNC
DALTP
                    , ZF
                                       ,21
                                                           , ZC
          , ETAR
EWF8
          , TFFHF
                    ,TFFIP
                             , TFFLP
                                       ,PCBLF
                                                 ,PCSLI
                                                           , PCBLC
                                                                    .PCBL DUT
FP BLOUC, PCELOBI, PCBLOBC, PCBLHFI, PCBLHPC, PCBLIFI, PCBLIPC, PCBLLPI,
GP' BLLFC
 C:MHON/
            SIDE/
                             , XWAC
                                       , XBLF
                                                 ,XBLDU
1 XP 1
          , XHAF
                    ,XWAI
                                                          ,XBLOUI ,XBLDUC
                             , XP21
                    ,XT21
                                       , X+21
                                                 .XS21
2 XH 20
          , XH3
                                                           . DUMS1
                                                                    • DUMS 2
                             ,523
                                                 ,P24
          ,P23
                                                                    ,524
                                       , 124
31.3
                    ,H23
                                                           ,H24
                                                 ,P28
                             , $25
          ,P25
                    ,H25
                                       , 728
                                                           ,H28
4T. >
                                                                    ,S28
5 T? 3
          , F29
                    ,H29
                             ,529
                                       , DUMS3
                                                 DUHS4
                                                           • DUMS 5
                                                                    ,DUMS 6
6 H, )
          , WF C
                    , HG24
                             ,FAR24
                                       ,ETAD
                                                 , OPDUC
                                                           ,BYPASS
                                                                    , DUMS 7
                             , AH28
71 23
          , FS 28
                    ,V28
                                       ,TS29
                                                 ,PS29
                                                           , V29
                                                                    , AH29
 CEMM JE /
             EACK/
X X \ 5 i
        . XP55
                         ,XS55
                 ,XH55
                                  , XT25
                                           , XP25
                                                   , XH25
                                                            , XS25
                                  ,XHG24 ,XFAR24,XXP1
X XH Fig.
         ,XHG55
                 .XFAR55.XWFD
                                                            . DUMB
        ,P6
                 ,H6
                         ,56
                                  ,17
                                          , P7
                                                   , H7
                                                            ,57
3 TE
                                  , 19
                                           , P9
418
                                                   ,H9
         ,PH
                 ,H8
                          , S8
                                                            ,59
                          ,FAR7
                                  , ETAA
                                           , DPAFT , V55
5 W6 5
         , WFA
                 ,WG7
                                                            , V25
         , V6
                 ,AH6
                          ,TS7
                                  ,PS7
                                           , 47
                                                   ,AH7
                                                            , AH25
6 FS 6
                                           ,PS9
                                  ,TS9
                                                   , 49
                                                            ,AH9
7153
         ,PS8
                 , V 8
                          ,AM8
                                                   ,FGPD
         ,FRD
                 ,VJD
                                  , VJH
                                           , FGMH
                                                            , FGFM
AV 8
                          ,FGMD
                                  ,FART
                                                   ,FN
9 FC H
         , F GP
                 , HFT
                          , WGT
                                           , FG
                                                            ,SFC
 ECTIVALENCE(TRASH1(1), PONFGU), (TRASH2(1), T1), (TRASH3(1), XP1)
```

```
EQUIVALENCE (TRASH4(1), XT55)
      DATA AHORDZ6HCOHHON/
      WRITE (6, 188) HORD
      HO RD = ANORD
      WRITE (6, 102) WORD, ZF, PCNF, ZI, PCNI, ZC, PCNC, T4, MODE
      WRITE (6, 103)
      HRITE (6, 104) (TRASH1 (I), I=1, 96)
      WRITE (6, 105)
      HRITE(6,104)(TRASH2(I),I=1,121)
      WR ITE (6, 105)
      HRITE(6,104)(TRASH3(I),I=1,56)
      HRITE (6, 103)
      WRITE(6,104)(TRASH4(I),I=1,72)
      HR ITE (6, 103)
      HRITE(6, 106) LCOPER
      IF (IDUMP.EQ.0) GO TO 2
      WRITE (6, 105)
      CALL SYG(2)
      CALL ENGBAL
2
      RETURN
      FORMAT(28HOAN ERROR HAS BEEN FOUNC IN , A6)
100
 102
      FORMAT(1H0, A6, 9x, 7E15.6, I4)
103
      FORMAT(2HD )
104
      FORMAT(1H0,8E15.6)
105
      FORMAT(1H1)
      FORMAT (25HOFAILED TO CONVERGE AFTER, 14, 6H LOOPS)
106
```

```
SUBROLTINE SYG(ICON)
       CIMENSION WORD (132)
       DATA ONEDOL/6H$
       GO TO (1,2), ICON
       END FILE 8
1
       REWIND 8
      RE TURN
C
          TERMINATE THE FILE
      WRITE (8,500)
500
      FORMAT (12H$$$$$$$$$$$$)
      END FILE 8
      REHINC 8
          READ RECORD
C
      RE AD (8,501) (WORD (I), I=1,132)
501
      FORMA) (132A1)
C
          CHECK FOR 12 LEADING DOLLAR SIGNS
      00 10 I=1,12
      IF (HORD(I) -ONEDOL)11,10,11
10
      CONTINUE
      RETURN
         CHECK FOR 6 TRAILING BOLLAR SIGNS
11
      DO 15 I=1,132
      IF (WORD(I) -ONEDOL)15,12,15
:2
      K= I+5
      00 13 J=I,K
      IF (WORD(J) -ONEDGL)15,13,15
. 3
      CONTINUE
      GO TO 20
15
      CONTINUE
      WRITE (6,502)
      FORMAT(1H0,12HERROR IN SYG)
,02
      REYURN
         PRINT LINE
      I= I - 1
      WRITE (0,505) (WORD(M), M=1,I)
 505 FORHA: (132 A1)
      GO 10 5
      GND
```

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SUBROUTINE THCOMP(PR,ETA,T,H,S,P,TO,HO,SO,PO)
PO=P#FR
TP=T#PR##0.28572
DO 1 I=1.25
CALL THERMG(FO,HP,TP,SP,X1,0,X2,0)
DELS=SP-S
IF (ABS(DELS).LE.0.00005\*S) GO TO 2
1 TP=TP/EXP(4.#DE!S)
CALL ERROR
2 HO=H+((HF+H)/ETA)
CALL THERMG(FO,HC,TO,SO,X1,0,X2,1)
RETURN
END

SUBROLTINE THTURB(OH, ETA, FAR, H, S, F, TC, HC, SO, PC)
HO = H - CH
HCP = H - DH / ETA
PT = P / 2.

CO 1 I = 1, 25

CALL THERMC(FT, HOP, TT, ST, AHHT, 1, FAR, 1)
CLLS = ST - S
IF (ABS(DELS) • LE • 0 • 00005 \* S) GO TO 2

1 PT = P \* EXP(DELS \* AHHT/1 • 986375 + ALOG(FT/P))
CALL ERROR
PO = PT
CALL THERMC(FO, HO, TO, SO, X1, 1, FAR, 1)
RETURN
ENO

```
SUBPOUTE I PROCOM(FARX, ) TY, USEN. (KEX, CPEX, REX, PHI, HEX)
      IF (F .. . X . LE . 6 . 9 . . 73 ) 60 TO 1
      FARX=8 067623
      WRITE (8, 101)
      IF (TEX.GE.300.) GO TO 2
1
      Tu Y=300.
      at ITE (8, 192)
      IN (TEX.LE. 4600.) GO TO 3
Ë
      TL X=4000 .
      WRITE (8.103)
3
      IF (FARX.GE.G.U) GO TO 4
      FARX = 0.0
      WRITE (8, 104)
C
      AIR PATH
      CPA = {{{\(\)}(\) (1.u11554GE-25*TEX-1.452677GE-21)*TEX
     1+7.62157 7E-18)+TEX-1.5128259E-14)+TEX-6.7178376E-12)
     2*TEX+6.5019486E-u8)*TEX-5.1536879E-05)*TEX+2.5020J516-J1
      HEA=((((((((1.2644425E+26*TEX-2.1752522E-22)*TEX
     2+2.18398267+08)*TEX+2.57+3440E=05)*TEX+2.5623.51E=01)*TEX
     3-1.75588364663
      1-2.4211288E-22)*!EX+1.5243153E-18)*TEX-3.782u648E-15)*TEX
     2-2.23927902-12) *TEX+3.2759743E-08) *TEX-5.1576679E-05) *TEX
     3+4.5432300E-02
      IF (FARX.LE.G.O) GO TO 5
      FUEL/AIR PATH
      CPF = ((((((7.2678710E-25*TEX-1.3335668E-20)*TEX
     1+1; J212913E-16) **EX-4: 20511.4E-13)*TEX+3:9686793E=1u) *TEX
     2-1.3?719J1E-96)*TEX+1.225863JE-03)*TEX+7.3816638E-&2
     HEF=(((((((((9.08483+8E-26*TEX-1.9050949E-21)*TEX
     1+1.7u21525E-17)*TEX-8.4102203E-14)*TEX+2.4921698E-10)*TEX
     2-4.590633Lf-07)*TEX+6.129315Jd-04)*TEX+7.3616638d-02)
     3 +T EX+3.058 1530L+01
      SeF=+7,3816638E-u2* 1_0G(TEX)+(((((1.u382670E-25*TEX
     1-2.222611 c-21)*TEX+2.u425326E-17)*TEX-1.0512776E-13)*TEX
     2;3.3228928c-10)*TIX-6.88595UFE-07)*TEX+1.2258630E-03)*TEX
     3+6.4833936~63
      CPEX= (CPA+FA:x: : . . (1.+FARX)
5
      HE X= (HEA+FARX: HL+) / 11++FARX)
      AMW=28.97-.946186*FARX
      R"Y-1.986375 184
      WLX=CPE / (Cr: mREW)
      CS EX = SQRT ( AK & X* R E ( * 1 .. X * 25031.37 )
      RETURN
      FORMAT(1H, :63HINPUT FULL-AIP TOTIC ABOVE LIMITS, IT HAS BEEN RESET
101
     210 0.067623,CH$$$$$$;
102
      TURMATITHE DISTRICCOM INFLT TEMPERATURE BELOW 300.,6H$$$$$$)
      FORMAT(1H0,36HPROCOM 1NPUT NUMPERATURE ABOVE 4000..6H$$$$$$)
103
      FORMAT(1HU, 38HPPCCOM IMPUT WEL-AIR RATIO BELCH ZERO, 6H$3$3$2)
104
      END
```

```
SUBROUTINE SEARCH (P,A,B,C,D,AX,NA,BX,CX,DX,NO,NAH,NGH,NCODE)
       DIMENSION AX (NAK), BX (NAM, NOM), CX (NAM, NOM), DX (NAM, NOM), NO (NAM), Q (9)
      NEEDS SUBROUTINE AFQUIR
       AX AND BX KUST BE STORED LO TO HI
  *** P= INPUT PRCPORTION BETWEEN 0.0 AND 1.6
       IF NOT INPUT. P MUST EQUAL -1.
  ***
       NC ODE = DS
                    OK
C
       NC 00 E = 01
                    A LO
C
C
       NC ODE = 02
                    A HI
C
                    ERROR
       NC 00E = 07
C
       NC ODE=10
                    B LO
                    B HI
C
       1800E=20
       NC 00E = 0
       C= 0 .
       0=0.
C *** FIND A
       CO 1 I=1,KA
       IH = I
       IF (A.LT.AH(I)) GO TO 2
1
       CONTINUE
       IF (A.GT.AX(IH)) NCOGE=2
       (HI) XA=A
       GO TO 3
2
       IF (IH. ST.1) GO TO 3
       NC 00E=1
       IH=2
       A= AX (1)
3
       IL=IH-1
       LIMH=NO(IH)
       LINL = NO(IL)
       FIND B
       FRM=(A-AX(IL))/(AX(IH)-AX(IL))
       PP =D
       IF (P.GE.O.) GO TO 6
       BL = 3 x (IL,1) + FRM + (BX (IH,1) - BX (IL,1))
       PH=3x(IL,&IML)+PRM*(BX(IH,&IMH)~Bx(IL,&IML))
       IF (3.6E.BL) GO TO 4
       NC ODE=NCODE+10
       e= aL
       GU 10 5
       IF ( LE.BH) GO TO 5
       NU FUE = NCODE+20
       8=3-
5
       PF=1.5
       G(Z) = 0.
       Q(2) = 0.
       8H=PP*(8X(IH,LINH)-8X(IH,1))+8X(IF,1)
6
       BL = PP^*(8 \times (IL, LIML) - 8 \times (IL, 1)) + 8 \times (IL, 1)
       DO 7 J=2, LIMP
       JH = J
       IF (BH.LT.BX(IH,J)) GO TO B
7
       SUMITMED
8
       JL = JH-1
       GO 9 K=2,LIML
       KH = K
```

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IF (BL.LT.BX(IL,K)) GO TO 10
       CONTINUE
       KL =KH-1
10
       PR=(BX(TH, JL)-BH)/(BX(IH, JH)-BX(IH, JL))
       CH= CM(1H, JL)-PR +(CX(IH, JH)-CX(IH, JL))
       DH= UX(IH: JL)-PR *(DX(IH,JH)-DX(IH,JL);
       PR=(BX(IL+LL)+BL)/(BX(IL,KH)+BX(IL,KL))
       CL = CX(^{9}L, KL) \cdot P(^{8}CX(IL, KH) - CX(IL, KL))
CL = CX(^{9}L, KL) \cdot P(^{8}CX(IL, KH) - CX(IL, KL))
        BT=BL+PRM+ (C.M-3L)
        CT = CL + PRN* (CH+CL)
        DT=DL+FPH+ (OH-DL)
        IF (P. .... ) GO TO 13
        DIR=SORT (B/ET)
        ERP=10-61) /8
        CALL 4FOUIR(Q(1), F7, ERR, 0., 25., 0.001, DIR, PT, ICON)
        GO 10 (15, 17, 12) , ICON
        PSUS.PT
        $F (PP ,LT . ) .. /P=0.
        1F (PP.6T.1. PP=1.
        GO TO 6
        NC COE #7
 12
        E= BT
 13
        C=CT
        0=07
        RETURN
         EN D
```

ALTERNATION OF THE PROPERTY OF

```
SUBROUTINE CONVRG(TI, HI, PI, SI, FAR, HG, PA, IDES, AO, PR,
     1 TO, 47, PO, SC, TSO, PSO, VO, AMO, ICON)
                   SUBSCNIC, COMPARE PI WITH PR
       IC 0 N = 1
                   SONIC, COMPARE PI WITH PR
C
       ICON=2
                   ERROR
       IC 0N=4
       A1=778.26
       CapsF=2116.217
       G= 32.174049
       CALL FROCOM(FAR, TI, XX1, XX2, XX3, XX4, PHII, XX6)
C *** SONIC CALCULATIONS
       ڻ ∸ل
       TS S= 0.833* TI
       J=J+1
1
       CALL PROCON(FAR, TSS, CSS, AKS, CP, REXS, PHISS, HSS)
       HL CAL = HI - CSS + + 2/(2, +G+AJ)
       DELHS = HS CAL-HSS
       IF (A8S(DEL HS) -0.0005+HSCAL) 4,4,2
       TSS=TSS+DELHS/CF
2
       IF ( 1-15) 1, 1, 3
       IC ON= 4
3
       RETURN
       IF (IDES) 12,12,5
  *** ISENTROPIC EXPANSION CALCULATIONS
5
       J= 0
       TS I=TI* (PA/PI)**0.286
       J= J+1
       CALL THERMO (PA, HSI, TSI, SSI, XX1, 1, FAR, 0)
       IF (ABS(SSI-SI)-0.0001#SI)8,8,7
       TSI=TSI/EXF(4.*(SSI-SI))
7
       IF (J-30)6,6,3
       V'SSORT (2. +G+AJ+(HI-HSI))
       IF -15-USS)9,11,11
      SUBSERVE DESIGN, CALCULATE AO
9
       VO=VIS
       T > C = 151
       PS ( PA
       CALL PROCOM(FAR, TSO, CSO, XX2, XX3, REX, PHISO, HSO)
       RH(= CAFSF* FSC/(AJ*REX*TSO)
       AU-WG/(RHO*VC)
       AKC= VL/CSO
       PP : 1 1
       I( 0N= 1
       TO=1 I
10
       HI-HI
       PU=PI
       S0=11
       RETURN
C *** SUNTE DESIGN, CALCULATE AO
```

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```
VO=CSS
11
      TSO=TSS
      PS 0=PI*(TS 0/TI) **(AKS/(AKS-1.))
      RHO=CAPSF*FSO/(AJ*REXS*TSC)
      AO=WG/(RHO+VC)
      AN 0=1.0
      PR=PI
      ICON=2
      GO TO 10
     NON-DESIGN, CALCULATE CRITICAL CONDITIONS
12
      VO=CSS
      750=TSS
      PS 0= PA
      RHO=CAPSF*PSO/(AJ*REXS*TSO)
      AOCRIT=HG/(RHO+VO)
      AM 0=1.0
      PR=PSO+(TI/TSO) ++(AKS/(AKS-1.))
      IF (AO-AUCRIT) 13, 13, 14
C *** NON-DESIGN, CRITICAL AND SUPERCRITICAL CONDITIONS
      FS 0=PSO* ACCRIT/AC
13
      PR=PR*AOCRIT/AO
      ICON=2
      GO TO 10
C *** NON-DESIGN, SUBSONIC CALCULATIONS
      250=PA
14
      J= 0
      TS 0 = 0 . 833 TS G
45
      J= J+1
      CALL PROCOM(FAR, TSO, CSO, AKO, CP, REX, ('HISO, HSO)
      RHO=CAPSF*FSE/(AJ*REX*TSO)
       VO=WG/(RHO +AO)
      HS CAL =HI-VC++2/(2.+G+AJ)
      DELHS=HSCAL-HSO
      IF (ABS(DELES)-0.0005*HSCAL)17,17,16
      TSO=TSO+DELHS/CP
16
       IF (J-15) 15,15,3
17
       AM O= VO/CSO
      FR=PSO+(TI/TSO) ++(AKO/(AKO-1.))
       IC ON=1
       GO TO 10
```

,我们的是一个人,我们们们的是一个人,我们们的是一个人,我们们的是一个人,我们们们的是一个人,我们们们的是一个人,我们们们们的是一个人,我们们们们们的一个人,他

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SUBROUTINE CONDIVITI, HI, PI, SI, FAR, NG, FA, IDES, AT, 40, FIR,
     1 TI, HT, PT, ST, TC, HO, PO, SO, TST, TSO, PST, PSO, VT, VO, AMT, AMO, ICON)
              SUBSCNIC, COMPARE PIR WITH PI
       IC 'N=1
               SONIC, SHOCK INSIDE NOZZLE, COMPARE PIR HITH PI
C
               SONIC, SHOCK OUTSIDE NOZZLE, COMPARE PIR WITH PI
C
      ICON=3
      IC 34=4
               ERROR
      CIMENSION G(9)
      2(2)=0.
      G(3) = 0.
      AJ = 778.26
      CAPSF=2116.2170
      G= 32.174049
      CALL FROCOM(FAR, TI, XX1, XX2, XX3, XX4, PHII, XX6)
C *** SONIC CALCULATIONS
       J= 3
      TS S=0.833*TI
1
       J= J+1
      CALL PROCOM(FAR, TSS, CSS, AK, CP, REXS, PHISS, HSS)
       HS CAL =HI -CSS++2/(2.+G+AJ)
       CELHS=HSCAL-+SS
       IF (ABS(OEL HS) - 0.0005*HSCAL) 4,4,2
       TSS=TSS+DELHS/CP
       IF (J-15) 1.1.3
       ICON=4
3
       RETURN
       IF (10ES) 11,11,5
C *** SONIC DESIGN, CALCULATE AT
       YT = CSS
       IST=TSS
       PST=PI+(TST/TI)++(AK/(AX-1.))
       RH O= CAPSF+FST/(AJ+REXS+TST)
       AT = HG/(RHO +VT)
       AM T = 1.0
C *** IDEAL EXPANSION DESIGN, CALCULATE AO
       FS O=FA
       J= 0
       TR 0= TI* (PSC/FI) **.286
       CALL PROCOM (FAR, TSO, CSO, AK, CP, REX, PHISO, HSO)
       PHIJAL=PHII-REX+ALOG(PI/PSO)
       DELPHI = PHICAL - PHISO
       IF (A85 (DELPHI) - 0.0001 PHICAL) 8,8,7
7
       TSC=TSO*EXP(4.*DELPHI)
       IF (J-15)6,6,3
       VO = S ] RT (2. +G + AJ + (HI-HSO))
       ANO=VO/CSO
       AO=(AT/AMO)+(2,+(1,+(AK-1,)+AHO++2/2,)/(AK+1,))++((AK+1,)/(2,+
      1 (AK-1.))
       FIR=PI
```

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ICON=3
9
      TO=T1
      HO =HI
      PO=PI
      S0 = S I
10
      TT=T1
      HT =H I
      FT =PI
      ST=SI
      RETURN
C *** ASSUME SONIC THROAT AND ISENTROPIC EXPANSION TO AC
      V" - " _ _ .
11
      AM == 1.5
        1:155
      式(Om HG/《AT サVT》
      PS T=RHO+AJ+REXS+TST/CAPSF
      PIR=PST+(TI/TST)++(AK/(AK-1.))
      IF (PST-PA) 12,24,24
12
      TS 0=0.95*TI
      MA M= B
13
      CALL FROCOF (FAR, TSO, CSO, AK, CP, REX, PHISO, HSO)
      AM G=SQRT (2.*((TI/TSO)-1.)/(AK-1.))
      AO CAL=(AT/AMO)+(2.+(1.+(AK-1.)+AHO++2/2.)/(AK+1.))++((AK+1.)/
     1(2.*(AK-1.)))
      EA=(AO-AOCAL)/AC
      DIR=SQRT (AQ/AQCAL)
      CALL AFQUIR(Q(1):TSO,EA,0.,100.,0.0001,DIR,TSOT,JCON)
      GO TO (14,15,3), JCON
14
      ISO=ISOT
      IF (TSC-TI) 160,13,141
140
      TSG=2.*TI/(AK+1.)
      IF (TSO.GT.TSC) GO TO 142
141
      TS0=0.98*TI
      GO TO 13
      IF (Q(2).LT.30.0.OR.AMO.LT.0.95.OR.MAM.EQ.1) GO TO 13
142
      TS 0=2. +T I/ (2.+0.98 + (AK-1.))
      MAH=1
      GO TO 13
15
      FSO=PIR*(TSO/TI) ## (AK/(AK-1.))
      IF (PSO-PA) 17,16,24
C *** CRITICAL FLOW, ISENTROPIC EXPANSION TO PA
      VO = A M O + C S O
16
      IC ON=1
      GC TO 9
C *** SUBSONIC FLOW
17
      FS 0=PA
      Q(2) = 0.
      Q(3) = 0.
      J= 0
      TS 0= 0.833*TI
```

```
18
       J= J+1
      CALL PROCOF(FAR, TSO, CSO, AK, CP, REX, PHISO, HSO)
      RHO=CAPSF*FSC/(AJ*REX*TSO)
       VO = WG / (RHO #AO)
      HS CAL=HI-VC+*2/(2.+G+AJ)
      CELHS=HSCAL-HSO
      IF (ABS(DEL HS) -0.0005*HSCAL) 20, 20, 19
      TSO=TSO+DELHS/CF
19
      IF (J-15) 18,18,3
20
       AM 0= VO/C SO
       FIR=PSO+ (TI/TSO) ++ (AK/(AK-1.))
      TST=TSO
21
      CALL PROCOM(FAR, TST, CST, AK, CP, REX, PHIST, HST)
      PST=PIR*(TST/TI)**(AK/(AK-1.))
      RHO=PST+CAFSF/(AJ+REX+TST)
      VT = HG/(RHO*AT)
      HS CAL =HI-VT++2/(2.+G+AJ)
      EH=(HSCAL-HST)/HSCAL
      DIR=1.+(HSCAL-HST)/(CP+TST)
      CALL AFQUIR(Q(1), TST, EH, 0., 20., 0.0005, DIR, TSTT, JCON)
      GO TO (22, 23,3), JCON
22
      IST=ISTT
      GO TO 21
23
      AM T= VT/CST
      IC ON=1
      SU TO 9
C *** SUPERCRITICAL FLOW, ISENTROPIC EXPANSION TO PA
      PS 0=PA
24
      J= 0
      TS 0= Y I* (PSC/PIR) **. 286
25
      J=.J+1
      CALL FROCON(FAR, TSO, CSO, AK, CP, REX, PHISO, HSO)
      PHICAL=PHII-REX+ALOG(PIR/PSO)
      CELPHI=PHICAL-PHISO
      IF (ABS(DELPHI)-0.0001*PHICAL)27,27,26
26
      TSO=TSO*EXF(4.0*DELPHI)
      IF (J~15) 25,25,3
      VO=SQRT(2.*G*AJ*(HI-HSO))
27
      AMU=VC/CSO
      AOI3=(AT/AMO)+(2.+(1.+(AK-1.)+AMO++2/2.)/(AK+1.))++((AK+1.)/
     1 (2.* (AK-1.)))
      IC CN=3
      N= G
      IF (40-A0ID)28,9,29
C *** SUPERCRITICAL FLOW, ISENTROPIC EXPANSION TO AO
28
      N= 1
      TS 0 = 0 . 833 TI
29
      J=0
30
      J=J+1
      CALL PROCOF (FAR, TSO, CSO, AK, CP, REX, PHISO, HSO)
      AMO=SORT (2.*((TI/TSO)-1.)/(AK-1.))
```

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ADCAL=(AT/AMC)+(2.+(1.+(AK-1.)+AMC++2/2.)/(AK+1.))++((AK+1.)/
     1 (2.* (AK-1.)))
      CELA=AO-AOCAL
      IF (ABS(DEL A) -0.0061 +AO) 32, 32, 31
       ISO=TSO+SQRT (AOCAL/AO)
31
      IF (J-50) 30,30,3
32
      IF (N) 34, 34, 33
C *** UNDEREXPANCEG. SHOCK OUTSIDE NOZZLE
33
      PS 0=PIR+ (TSO/TI)++(AK/(AK-1.))
       VO=AHC+CSO
      GO TO 9
C *** OVEREXPANDED. FIND SHOCK POSITION
      PS X=PIR+ (TSO/TI) ++ (AK/(AK-1.))
34
      PSY=PSX+(2.+AK+AHO++2/(AK+1.)-(AK-1.)/(AK+1.))
       IF (PA-PSY) 35,36,36
C *** OVEREXPANDED, SHOCK OUTSIDE NOZZLE
35
       PS 0=PSX
       VO=AMC+CSO
       GO TO 9
C *** OVEREXPANDED. SHOCK INSIDE NOZZLE
36
       PS 0=PA
       J= 0
       TS 0=0.833+TI
37
       J=J+1
       CALL PRUCOF (FAR, TSO, CSO, AK, CP, REX, PHISO, HSO)
       RHO=CAPSF+PSC/(AJ+REX+TSO)
       VO = WG/(RHQ +AC)
       HSCAL=HI-VO++2/(2.+G+AJ)
       DELHS=HSCAL-HSO
       IF (ABS (DEL HS) -0.0005*HSCAL) 39, 39, 38
38
       TSO=TSO+DELHS/CF
       IF (J-15) 37,37,3
39
       AM 0= VC/CSO
       TO=TI
       HO=HI
       PO=PSO+(TO/TSO) ++(AK/(AK-1.))
       SO=PHII-REX*ALOG (PO)
       IC ON = 2
       GO TO 10
       END
```

```
SUBROUTINE 'FQUIR(X, AIND, DEPEND, ANS, AJ, TOL, DIR, ANEH, ICON)
                        DIMENSION X(9)
                  C X(1) =NAME OF ARRAY TO USE
                  C AIND=INDEPENDANT VARIABLE
                  C DEPEND = DEPENDANT VARIABLE
                  C ANS=ANSHER UPON WHICH TO CONVERGE
                  C AJ=MAX NUMBER OF TRYS
                  C TOL=PERCENT TOLERANCE FOR CONVERGENCE
                  C DIR-DIRECTION AND PERCENTAGE FOR FIRST GUESS
                  C ANEH=CALCULATED VALUE OF NEXT TRY AT INDEPENDANT VARIABLE
                  C ICON=CONTROL
                                  =1 GO THRU LOOP AGAIN
                  C
                                   =2 YOU HAVE REACHED THE ANSWER
                                   =3 COUNTER HAS HIT LIMITS
                 C X(2) = COUNTER STORAGE
                 C X(3) =CHOOSES METHOU OF CONVERGENCE
                 C X(4) =THIRD DEPEND VAR
                 C X(5) =THIRD IND VAR
                   X(6) =SECOND DEPEND VAR
                   X(7) =SECOND INC VAR
                   X(8) = FIRST DEPEND VAR
                 C X(9) =FIRST IND VAR
                 C X(3) MUST BE ZERO UPON FIRST ENTRY TO ROUTINE
                        Y= 0 .
                        IF (ANS) 1,2,1
                 1
                        DE P = DEPEND -ANS
                        TOLANS=TOL*ANS
                        60 TO 3
                 2
                        DE P=DEPEND
                        TOLANS=TOL
                 3
                        IF (ABS(DEP)-TOLANS) 5,5,4
                        IF (X(2)-AJ)8,8,7
                 5
                        ANEH= AIND
                        X(2)=0.
6
7
8
C ***
9
                        IC ON = 2
                        RETURN
                        AN EH = Y
                        X(2) = X(2) + 1.
                        IC 01=1
                        RETURN
                        AN EH = Y
                        X(2) = 0.
                        IC ON=3
                        RETURN
                        IF (Y(3)) 9, 9, 12
                       FIRST GUESS USING DIR
                        x(3) = 1.
                        X(8) = DEP
                        X(9) = AIND
                        IF (AIND) 10,11,10
                        ONIA*AJC=Y
                        60 TO 6
                        Y=DIR
                        GG TO 6
                        IF (X(3)-1.)13,13,16
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C *** LINEAR GUESS
       x(3) = 2.
13
       X(6) = DEP
       X(7) = AIND
       IF (X(8)-X(6))14,9,14
14
       IF (X(9)-X(7))15,9,15
15
       A= \{X(9, -X(7))/(X(8)-X(6))
       Y=X(9)-A+X(8)
       IF (ABS(10. *X(9)) - ABS(Y)) 9,9,6
C ***
       QUADRATIC GUESS
16
       X(4) = DEP
       X(5) = AIND
       IF (X(7)-X(5))18,17,18
17
       IF (X(6)-X(4))13,9,13
18
       IF (X(6)-X(4))19,13,19
19
       IF (X(9)-X(5))23,20,23
20
       IF (X(8)-X(4))21,22,21
21
       X(9) = X(7)
       X(8) = X(6)
       GO TO 13
22
       X(9) = X(7)
       x(8) = x(6)
       X(3) = 1.
       IF (X(9))10,11,10
       IF (X (8) - X (4) ) 24, 21, 24
23
24
       F = \{X(6) - X(4)\} / (X(7) - X(5))
       A = (X(8) - X(4) - F + (X(9) - X(5))) / ((X(9) - X(7)) + (X(9) - X(F)))
       B=F-A*(X(5)+X(7))
       3=X(4)+X(5)*(4*X(7)-?)
       IF (A) 242, 240, 142
240
       IF (8) 241,7,241
       Y=-C/8
241
       GO TO 37
       IF(B)247,243,247
242
243
       IF (G) 245,244,245
244
       Y= 0 .
       GO TO 37
245
       G=-C/A
       IF (6) 7,7,246
246
       Y= SORT (G)
       YY =- SQRT (G)
       GO TO 270
247
       IF (C) 249,248,249
248
       Y=-8/4
       YY -0 .
       GO TO 270
       0=4. *A+C/B**2
249
       IF (1.-0) 13,25,26
25
       Y=-8/(2, #A)
       GO TO 37
       E=SQRT(1.-D)
26
       Y= (-B/(2.*A)) +(1.+E)
27
       YY=(-8/(2. +A))+(1.-E)
270
       J= 4
       DEPMIN=A8$ (X (4))
```

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DO 29 I=6,8,2
       IF (DEPMIN-ABS(X(I)) 129, 29, 28
28
       J= I
       DEPHIN=ABS (X (I))
29
       CONTINUE
       K=J+1
       IF ((x(K)-Y)+(x(K)-YY))32,32,30
       IF (ABS(X(K)-Y)-ABS(X(K)-YY))37,37,31
30
31
       Y= YY
      GO TO 37
      IF (J-6) 33, 34, 34
32
33
       JJ=J+2
      KK = K+2
      GO TO 35
34
       JJ=J-2
      KK=K-2
35
      SL GPE=(X(KK)-X(K))/(X(JJ)-X(J))
      IF (SLCPE*X(J)*(X(K)-Y))36,36,37
36
      Y=YY
37
      X(9) = X(7)
      X(8) = X(6)
      X(7) = X(5)
      X(6) = X(4)
      GO TO 6
      END
```

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```
SUBROUTINE MATRIX(E, V, A)
     DIMENSION E(9,9), V(9), A(9), PIV(10), T(9,10)
     00 1 I=1,9
     T(I, 10) = A(I)
     DO 1 J=1,9
     T(I,J)=E(I,J)
     00 7 I=1,9
     TE MP=0.
     DO 2 J=I,9
     IF (TEMP.GT.ABS(T(J,I))) GO TO 2
     TE MP=ABS (T (J, I))
     IPIV=J
2
     CONTINUE
     IP1=I+1
     DO 3 J=IP1,10
3
     PIV(J)=T(IPIV,J)/T(IPIV,I)
     IFROM=9
     IT 0=9
     IF (IFRON.EC. IPIV) GO TO 6
     RM=-T(IFROM, I)
     DO 5 J=IP1,10
     T(ITO,J) = T(IFRON,J) + PM+PIV(J)
     IT 0= IT0-1
     IFROM=IFROM-1
     IF(IFRON.GE.I) GO TO 4
     DO 7 J=IP1,10
     T(I, J) = PIV (J)
     00 8 I=1,8
     J=10-I
     K=9-I
     00 8 L=J,9
8
     T(K, 10) = T(K, 10) - T(K, L) + T(L, 10)
     00 9 I=1,9
9
     V(I)=T(I,10)
     RETURN
```

END

```
SUBROUTINE OUTPUT
 GIMENSION +(5,4), ANS1(96), ANS2(121), ANS3(56), ANS4(72)
        ,IDES
                 ,JDES
                        ,KDES
                                  , MODE
                                          , INIT
1 HORD
                                                 , IGUMP , IAHTP ,
2 IG ASMX, IOBURN, IAFTBN, IDCD
                                ,IMCD ,IDSHOC, IMSHOC, NOZFLT,
3 IT RYS, LOOPER, NOAAP, NUMHAP, MAPENG, TOLALL, ERR (9)
 COMMON/DESIGN/
                                      , DUMD1
                                                         , DELFN
1 PCNFGU , PCNIGU , PCNCGU , T4GU
                                                .DELFG
                                                                   ,DELSFC ,
2 ZF DS
         ,PCNFDS ,PRFDS
                            , ETAFOS , WAFDS
                                                ,PRFCF
                                                          , ETAFCF , WAFCF
         ,PCNIDS ,PRIDS
3 ZI DS
                             , ETAIDS , WAIDS
                                                ,PRICF
                                                          , ETAICF
                                                                   , WAICF
                                                ,PRCCF
                                                          ,ETACCF
                                                                   , WACCF
4 ZC DS
         , PCNCDS , PRCDS
                             ,ETACDS ,WACDS
5 T4 DS
         . WF BDS
                   ,DTCODS ,ETABDS , WA3CDS
                                               ,DPCODS ,DTCOCF
                                                                   ,ETABCF
6TFHPOS, CNHPOS, ETHPOS, TFHPCF, CNHPCF
                                               ,ETHPCF ,DHHPCF ,T2DS
7TFIPOS , CNIPOS , ETIPOS , TFIPCF , CNIPCF
                                               ,ETIPCF ,DHIPCF ,T210S
8 TFLPOS , CNLPOS , ETLPOS , TFLPCF , CNLPCF
                                               ,ETLPCF ,DHLPCF ,T220S
         , WF DDS
9 T2 40S
                   ,OTOUDS ,ETADDS ,WA23DS
                                               ,OPDUOS ,DTDUCF ,ETADCF
AT7 DS
         , WF ADS
                   ,DTAFDS ,ETAADS ,WG6CDS
                                                ,DPAFOS ,OTAFCF ,ETAACF
                                      , A8
B A55
                            , A7
                                                ,A9
                                                          ,A28
                                                                   ,A29
         , A25
                   , A6
         , AH 55
CPS 55
                   ,CVDNOZ ,CVMNOZ ,A8SAV
                                                ,A9SAV
                                                          VAZBSAV , AZBSAV
 COMMON/ FRONT/
1 T1
         . P1
                   , H1
                             ,51
                                      ,T2
                                                ,P2
                                                          ,H2
                                                                   <sub>9</sub> $2
                             ,521
2T21
         ,P21
                   , H21
                                      ,T22
                                                .P22
                                                          ,H22
                                                                   *S22
                             , S3
         , P3
                                      ,T4
                                                ,P4
3 1 3
                   , H3
                                                          ,H4
                                                                   ,54
         , P45
4145
                                      ,T5
                                                ,P5
                   , H45
                             , 545
                                                          , H5
                                                                   .S5
5 T5 5
         , P55
                             , S55
                                      , BLF
                                                          ,BLC
                                                                   , BLDU
                   , H55
                                                , SL1
                             , HAFC
                                      , HAF
                                                         , BL DUC
6 CN F
         . PRF
                   , ETAF
                                                                   , BLOB
                                                BLDUI
         , PRI
                                      , HAI
                   ,ETAI
                             , WAIC
                                                         ,BLOBC
7 CN I
                                                , BLOBI
                                                                   , WA3
8 CNC
         , PRC
                   ,ETAC
                             , HACC
                                      , WAC
                                                ,ETAB
                                                          ,DROUH
                                                                   , WG4
         , ET ATHP
                   , DHT CHP
                            , DHTC
                                      ,BLHP
                                                                   ,FAR4
9 CN HP
                                                .BLHPI
                                                         , BLHPC
                   ,DHTCIP
                            , GHTI
                                                ,BLIPI
                                                                   , DUMF
A CN IP
         , ETATIP
                                      , BLIP
                                                          ,BLIFC
BCNLP
         , ETATLP
                   , DHTCLP
                            , OHTF
                                      , BLLP
                                                ,BLLPI
                                                          ,BLLPC
                                                                   ,CS
                                                          , HPEXT
C NG 45
         , FAR45
                   , NG5
                             ,FARS
                                      , HG55
                                                FAR55
                                                                   , AM
                   ,ZF
                             , PCNF
DALTP
                                                         , ZC
                                                                   , PCHC
         , ET AR
                                      ,ZI
                                                ,PCNI
EWFB
         , TF FHP
                   ,TFFIP
                             , TFFLP
                                      , PCBLF
                                                         ,PCBLC
                                                                   , PCBL DUI,
                                                ,PCBLI
FFC BL DUC, PC BL CBI, PCBLOBC, PCBLHPI, PCBLHPC, PCBLIFI, PCBLIPC, PCBLLPI,
GPC BLLPC
 COMMON/
           SIDE/
         , XHAF
                   , XHAI
                             , XHAC
1 XP1
                                      , XELF
                                                ,XBL DU
                                                         ,XBLOUI ,XBLOUC
                   , XT21
                             , XP21
2 XH 22
         , XH3
                                      , XH21
                                                ,XS21
                                                          DUMS1
                                                                   DUHS2
                             , $23
                                      ,T24
                                                          ,H24
3123
         .P23
                   ,H23
                                                ,P24
                                                                   .524
                   ,H25
                                                tP28
                                                         ,H28
                                                                   ,528
4 T2 5
         2 55 E
                             , $25
                                      ,T28
         ,P29
5 T2 9
                   ,H29
                             , 529
                                      ,DUMS3
                                                DUMS4
                                                          ,DUMS5
                                                                   , DUMS 6
                             ,FAR24
                                      ,ETAD
6 MA 0
         . WF C
                   * HG24
                                                . DPDUC
                                                         ,BYPASS ,DUNS?
          , PS 28
                   , V28
                             , AM28
7 TS 23
                                      ,1529
                                                ,PS29
                                                          , V29
                                                                   , AH29
             BACK/
 COMMON /
        ,XP55
                                  ,XT25
X XT 55
                                                 ,XH25
                 ,XH55 ,XS55
                                          , XP25
                                                           ,XS25
                                                           ,DUMB
XXWFB
        ,XWG55 ,XFAR55,XWFD
                                  ,XHG24 ,XFAR24,XXP1
                 ,H6
                                          , P7
        ,P6
                                  ,T7
316
                         ,56
                                                  ,H7
                                                           ,57
        ,P8
                         ,58
                                                           ,59
4 T8
                                          , P9
                 ,H8
                                  ,19
                                                  ,H9
        , HFA
                 ,WG7
                         ,FAR7
                                          , DPAFT , V55
5 kG 6
                                                           , V25
                                  ,ETAA
                                          , Y7
                 ,AM6
                         ,TS7
                                 ,PS7
                                                  ,AH7
                                                           , AH25
6 PS 6
        , V6
        ,PS8
                 , V 8
                         ,AH8
                                  ,TS9
                                          ,PS9
                                                  , 49
7 TS 8
                                                           ,AM9
        ,FRO
AV 8
                 OLV,
                         ,FGHD
                                  , VJH
                                          , FGHH
                                                  ,FGPD
                                                           , FGPH
                         , HGT
9FG N
        , FGP
                 ,WFT
                                          ,FG
                                                  ,FN
                                  ,FART
                                                           ,SFC
 EQUIVALENCE (ANS1(1), PCNFGU), (ANS2(1), T1), (ANS3(1), XP1)
```

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EQUIVALENCE (ANS4(1),XT55)
      DATA AWORD1, ANORUZ/6HOUTPUT, 6HCOMPON/
      DATA (N(1, I), I=1,4)/6HSUBSON,6HIC C-0,6H NOZZL,6HE
      DATA (N(2, I), I=1,4)/6HSHCCK,6HINSIDE,6H C-D N,6HOZZLE/
      DATA (H(3, I), I=1,4)/6HSHOCK,6HOUTSID,6HE C-D,6HNOZZLE/
      DATA (H(4, I), I=1,4)/6HSUBSON,6HIC CON,6HVERG. ,6HNOZZLE/
      DATA (W(5,1), I=1,4)/6HSONIC ,6HCONVER,6HGENT N,6HOZZLE /
      HORD=AHORD1
      IF(IDES.EG.1) GO TO 4
      IF (IDBURN. GT.0) GO TO 2
      IF (IAFTBN.GT.O) GO TO 1
      HRITE(6,100)HORD,AH,ALTP,T4,ETAR
      GO TO 3
1
      WRITE 66, 101) WORD, AM, ALTP, T4, T7, ETAR
      GC TO 3
2
      HRITE(6,102)HORD,AM,ALTP,T4,T24,ETAR
3
      CALL CONOUT(2)
      WRITE(6, 104) (W(IMSHOC, I), I=1,4), FG, FN, SFC
      IF (IGASMX.GT.O) GO TO 5
      WRITE(6,105)(W(IDSHOC,I),I=1,4)
5
      WRITE (6, 106) LOOPER
      HORD = AHORD 2
      HRITE(6, 107) HORD, ZF, PCNF, ZI, PCNI, ZC, PCNC, T4, HODE
      WRITE (6, 108)
      HRITE(6,109) (ANS1(I), I=1,96)
      HR ITE (6, 108)
      WRITE(6, 189) (ANS2(I), I=1, 121)
      WRITE (6, 108)
      WRITE(6,109) (ANS3(I), I=1,56)
      WRITE(6,108)
      \forall R \ ITE (6, 109) \ (ANS4(I), I=1,72)
      IF (IDES.EQ.1) GC TO 6
      A8 = A8SAV
      A9=A9SAV
      A28=A28SAV
      A2 9= A 29S AV
      IF (IDUMP.NE.2) GO TO 6
      WRITE (6,110)
      CALL SYG (2)
      CALL ENGBAL
      RETURN
100
      FORMAT(1H0.A6.14X7H
                                AM=, F7.3, 6X7H ALTP=,F7.0.
               T4=,F8.2,25X7H
                                ETAR=, F7.4)
     16X7H
                                AM=, F7.3, 6X7H ALTP=,F7.0,
1.01
      FORMAT(1H0,A6,14X7H
               74=, F8. 2, 5X7H
                                  T7=,F8.2,5X7H
                                                  ETAR= . F7 . 4)
102
      FORMAT (1HO,A6,14X7H
                                4H=, F7.3, 6X7H
                                                  ALTP=,F7.0,
               T4=, F3.2,5X7H
                                 T24=,F8.2,5X7H
     16X7H
                                                  ETAR=,F7.4)
       FORMAT(6HOMAIN ,4A6,9X3HFG=,F9.2,18X3HFN=,F9.2,18X4HSFC=,F8.5)
104
       FORMAT (6H CUCT ,4A6)
105
      FORMAT(16H1CCNVERGED AFTER, 14,6H LOOPS, /, 1H0)
106
       FORMAT(1H ,AE,9X,7E15.6,I4)
 107
       FORMAT(1H )
108
109
       FORMAT(1H ,8E15.6)
110
       FORMAT(1H1)
```

\* Maria Constant

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CNB

```
SUBROUTINE HAPBAC (HAP, HAPGO, TFFS, TFF, CNS, CN, PCN, T, HODE, IGO, NUH)
      DATA WH, WI, WE, WT, WS/6H H.P. , 6H I.P. , 6H L.P. , 6H TFF , 6HSPEED /
      FORMAT(1HU, AE, 12HTURBINE MAP, A6, 4HWAS=, E13.6, 10H AND NOH=, E13.6,
1
     16H$$$$$$)
      FORMAT(1H0, A6, A6, 22HWAS ALSO CHANGED FROM, E13.6, 5H TO, E13.6,
2
     1 6H 3S$$$$)
       IF (NUM. GT. 0) GO TO 3
      NU MH = 0
      NUMI=0
      NU ML = 0
      IG 0= MAPGO+ 3* (MAP-1)
3
       GO TO (100,200,300,400,500,600,700,000,900),IGO
      HIGH PRESSURE TURBINE
100
       TFF=TFF+0.1*(TFF-TFFS)
      HR ITE (8, 1) WH, WT, TFFS, TFF
       RETURN
200
       CN=CN+0. u5+(CN-CNS)
       IF (MOCE. NE.1) PCN=PCN+(CN/CNS)
       IF (MODE, EQ.1) T =T +(CNS/CN)++2
       HRITE (8, 1) bH, MS, CNS, CN
       IF (NUMH. GT.2) GO TO 210
       NUH=1
       NU MH = NUM H+1
       RETURN
210
       DELCN=CN-CNS
       IF (DELCN.GE.O.) RETURN
       TFF=TFF* (1.+CELCN/CN)
       WRITE (8, 2) KH, MT, TFFS, TFF
       RETURN
300
       TFF=TFF+0.1*(TFF-TFFS)
       hRITE(8,1) WH, WT, TFFS, TFF
       GO TO 200
C *** LOW PRESSURE TURBINE
       TFF=TFF+0.1*(TFF-TFFS)
+00
       HRITE (8, 1) WL, NT, TFFS, TFF
       RETURN
       CN=CN+0.05*(CN-CNS)
500
       IF (MODE.NE.3) PCN=PCN+ (CN/CNS)
       IF (MODE.EQ.3) T =T +(CNS/CN)
       HRITE (8,1) HL, HS, CNS, CN
       IF (NUPL. GT. 2) GO TO 510
       NU H=1
       NU ML = NUML + 1
       RETURN
510
       DELCN=CN-CNS
       IF (DELCN.GE.O.) RETURN
       TFF=TFF* (1.+CELCN/CN)
       HRITE (8,2) HL, HT, TFFS, TFF
       RE TURN
500
       TFF=TFF+0.1*(TFF-TFFS)
       HR ITE (8, 1) WL, HT, TFFS, TFF
       GO TO 500
C *** INTERMEDIATE SPOOL TURBINE
       TFF=TFF+0.1+(TFF-TFFS)
 700
       WRITE (8,1) WI, WT, TFFS, TFF
```

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RETURN CN=CN+0.05\*(CN-CNS) 800 IF (MODE. NE.3) PCN=PCN+(CN/CNS) IF (MODE.EQ.3) T=T+(CNS/CN) WRITE(8,1) WI, WS, CNS, CN IF (NUMI. GT.2) GO TO 810 NUH=1 NUMI=NUMI+1 RETURN DELCN=CN-CNS 810 IF (DELCN.GE. 0.) RETURN TFF=TFF+ (1.+DELCN/CN) WRITE (8,2) FT, NT, PFFS, TFF RETURN TFF=TFF+0.1+ (TFF-TFFS) 900 HRITE(8,1) WI, HT, TFFS, TFF GO TO 800

END

and the same that the same tha

SUBROUTINE THERMO (PX, HX, YX, SX, AMX, L, FAR, K) FX = 0. IF (L.EQ.1) FX=FAR IF (K.EQ.1) GC TC 1 CALL PROCOM(FX, TX, GS, AK, CP, R, PHI, HX) GO TO 3 TX =4 . \*HX 00 2 I=1,15 CALL FROCOM(FX,TX,CS,AK,CP,R,FHI,H) DE LH=HX-H IF (ABS(DELH) .LE.0.00001+HX) GO TO 3 TX=TX+4. \*DELH kRITE(8,100) FORMAT (31HONG CONVERGENCE IN THERMOSSS (\$5) 100 SX =PHI-R +A LOG (PX) 3 AMX=1.986375/R RETURN END

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SUBROUTINE RAM(AM, ETAR)
IF (AM.GT.1.) GO TO 2
ETAR=1.

RETURN
IF (AM.GT.5.) GO TO 3
ETAR=1.-0.075*((AM-1.)**1:35)
GO TO 1
ETAR=800./((AM**4)+935.)
GO TO 1
END
```

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```
FUNCTION GUESS(M,T,TO,P,PD,M,HD,C,DD,VD)
IF (M.EQ.0) GUESS=VD*((T/TD)**1.60)*((DD/D)**0.50)
IF (M.EQ.1) GUESS=VD*((P/PD)**1.80)*((DD/D)**0.33)
IF (M.EQ.2) GUESS=VD*((M/HD)**0.33)*((DD/D)**1.00)
IF (M.EQ.3) GUESS=VD*((M/HD)**0.00)*((P/PD)**0.50)
IF (M.EQ.4) GUESS=VD*((M/HD)**0.00)*((P/PD)**0.50)
IF (M.EQ.5) GUESS=VD*((T/TD)**1.10)*((DD/D)**0.60)
IF (M.EQ.6) GUESS=VD*((P/PD)**1.00)*((D/DD)**0.25)
IF (M.EQ.7) GUESS=VD*((P/PD)**1.2)*DD/D
IF (M.EQ.8) GUESS=VD*((T/TD)**1.2)*DD/D
IF (M.EQ.9) GUESS=VD*((D/DD)**1.5)
RETURN
END
```

```
BLOCK DATA CMEDAT
 COMMON / COME/PSI(15), DELT(15, 15), ETA(15, 15), N, NP(15)
 CATA N, NP/15, 15+15/
 DATA PSI/4.9116,9.8232,14.735,19.646,24.558,29.470,34.381,
139.293,44.207,73.674,100.,200.,300.,400.,500./
 DATA DELT/15*200.,15*300.,15*400.,15*500.,15*600.,15*700.,15*800
115+900.,15+1000.,15+1100.,15+1200.,15+1300.,15+1400.,15+1500.,
215*1600./
 DATA ETA/
1.600,.726,.777,.806,.826,.843,.855,.865,74.870,
2.758,.825,.858,.875,.388,.898,.906..912..914.6*.915,
3.868,.893,.911,.925,.935,.942,.947,.951,7*.953,
4.925, .936, .946, .955, .963, .969, .974, .977, .978, 6*.979,
5.960, .966, .972, .977, .982, .985, .990, .992, .993, 64.995,
6.988,.991,.992,.994,.995,.997,.998,8*.999,
78 1.00,7 . 999,120 1.00/
 END
```

```
BLOCK DATA FANDAT
 THIS IS A GENERALIZED FAN MAP FOR UNREALISTIC SUPERSONIC ENGINE
         FAN/CN(15), PR(15, 15), HAC(15, 15), ETA(15, 15), N, NP(15)
 DATA N.NP/10,6,347,5410,8,540/
 DATA CN/0.3,0.4,0.5,0.6,0.7,0.8,0.9,1.0,1.1,1.2,5*0./
 DATA (PR(1,J)
                ,J=1,6)/
C1.0000 ,1.0120 ,1.0280 ,1.0384 ,1.0448 ,1.0480 /
 DATA (HAC(1, J) , J=1,6 )/
C243.60 ,229.80 ,199.80 ,166.80 ,133.20 ,86.400 /
 DATA (ETA(1,J) ,J=1,6 )/
CO. 7559 , O. 7612 , O. 7665 , O. 7559 , O. 7251 , O. 6415 /
 DATA (PR(2,J)
                ,J=1,7 )/
C1.0000 ,1.0200 ,1.0400 ,1.0584 ,1.0752 ,1.0920 ,1.1000 /
 DATA (WAC(2,J) ,J=1,7 )/
C286.80 ,270.00 ,253.20 ,233.40 ,209.40 ,183.60 ,156.60 /
 DATA (ETA(2,J) ,J=1,7 )/
CO.7559 ,0.7762 ,0.7920 ,0.7973 ,0.5026 ,0.7762 ,0.7401 /
 DATA (PR(3,J)
                ,J=1,7 )/
C1.0000 ,1.0256 ,1.0512 ,1.0800 ,3.1160 ,1.1320 ,1.1480 /
 DATA (WAC(3,J) ,J=1,7 )/
C333.60 ,322.80 ,310.20 ,291.60 ,259.80 ,240.00 ,213.60 /
 DATA (ETA(3,J) ,J=1,7 )/
CO.7506 , 0.7762 , 0.8026 , 0.8281 , 0.8439 , 0.8281 , 0.7662 /
                ,J=1,7 )/
 DATA (PR (4,J)
C1.0000 ,1.0368 ,1.0880 ,1.1240 ,1.1600 ,1.1896 ,1.1952 /
 DATA (WAC(4,J) ,J=1,7 )/
C383.40 ,376.20 ,358.20 ,340.20 ,313.20 ,276.60 ,266.40 /
 DATA (ETA(4,J) ,J=1,7 )/
CO.7454 , D.7762 , D.8281 , D.8545 , D.8800 , D.8281 , D.8078 /
                , J=1,10)/
 DATA (PR(5,J)
C1.0000 ,1.0640 ,1.1184 ,1.1480 ,1.1840 ,1.2096 ,1.2176 ,
C1.2240 ,1.2440 ,1.2672 /
 DATA (WAC(5,J) ,J=1,10)/
C439.80 ,436.80 ,428.40 ,420.60 ,406.80 ,393.60 ,388.20 ,
C383.40 ,368.40 ,342.60 /
 DATA (ETA(5,J) ,J=1,10)/
CO. 7251 ,0.7762 ,0.8281 ,0.8545 ,0.8800 ,0.9011 ,0.9038 ,
CO. 9011 , 0. 8800 , 0.8281 /
                 ,J=1,10)/
 DATA (PR(6,J)
C1.0000 ,1.1000 ,1.1600 ,1.2000 ,1.2280 ,1.2552 ,1.2720 ,
C1.2864 ,1.3024 ,1.3320 /
 DATA (HAC(6,J) ,J=1,10)/
C499.81 ,499.80 ,493.20 ,485.40 ,476.40 ,466.80 ,456.60 ,
C448.20 ,433.20 ,406.80 /
 DATA (ETA(6,J) ,J=1,10)/
CO.6882 , 0.7762 , 0.8281 , 0.8545 , 0.8800 , 0.9011 , 0.9108 ,
C0.9011 ,0.8800 ,0.8272 /
 DATA (PR(7,J)
                 / (10 و 1=1 و
C1. 0000 ,1.0760 ,1.1520 ,1.2192 ,1.2600 ,1.2896 ,1.3312 ,
C1.3616 ,1.3912 ,1.4000 /
 DATA (WAC(7,J) ,J=1,10)/
C566.41 ,566.40 ,566.39 ,559.80 ,553.20 ,544.80 ,528.60 ,
C509.40 ,483.60 ,474.00 /
 DATA (ETA(7,J) ,J=1,10)/
```

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是一个时间,这个时间,我们就是一个时间,我们就是一个时间,我们就是一个时间,我们就是一个时间,我们也是一个时间,我们就是一个时间,我们就是一个时间,我们就是一个

CO.6415 , 0.7251 , 0.7762 , 0.8281 , 0.8589 , 0.8800 , 0.9011 ,

```
CO.8800 , 0.8281 , 0.8175 /
 DATA (PR(8,J)
                 ,J=1,10)/
C1.0000 ,1.0440
                 ,1.1352 ,1.2208 ,1.2944 ,1.3400 ,1.4000 ,
C1.4280 ,1.4480 ,1.4890 /
 DATA (HAC(8,J)
                 ,J=1,10)/
C633.61 ,633.60 ,633.59 ,633.00 ,625.80 ,616.80 ,600.00 ,
C586.80 ,576.60 ,553.20 /
 DATA (ETA(8, J) , J=1,10)/
CJ. 6002 , 0. 6415 , 0.7251
                         ,0.7762 ,0.8281 ,0.8589 ,0.8800 ,
Cu. 8589 , 0. 8281 , 0.7867 /
 CATA (PR(9,J)
                 ,J=1,10)/
C1.0000 ,1.1640 ,1.2206 ,1.3240 ,1.4000 ,1.4480 ,1.5000 ,
C1.5336 ,1.5680 ,1.5840 /
 DATA (WAC(9, J)
                ,J=1,10)/
C700.22 ,700.21 ,700.20 ,700.19 ,700.18 ,698.40 ,693.60 ,
C683.40 ,666.60 ,656.40 /
 GATA (ETA(9,J) ,J=1,10)/
CO. 5694 , O. 6415 , O. 7251 , O. 7762 , C. 8026 , O. 8078 , O. 8026 ,
CO.7762 ,0.7454 ,0.7251 /
 DATA (PR(10,J) ,J=1,8 )/
C1.0000 ,1.1632 ,1.3120 ,1.4000 ,1.4800 ,1.5400 ,1.5600 ,
C1.6600 /
 DATA (WAC(10, J), J=1,8 )/
C750.03 ,750.02 ,750.01 ,750.00 ,749.99 ,749.98 ,749.40 ,
C736.80 /
 DATA (ETA(10,J),J=1,8 )/
CO.5174 , 0.6415 , 0.7251 , 0.7559 , 0.7612 , 0.7506 , 0.7251 ,
C0.6415 /
 END
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BLOCK DATA INTOAT
 THIS IS A GENERALIZED INT. COMP. PAP FOR UNREALISTIC SUPERSONIC EN
         INT/CN(15), PR(15,15), WAC(15,15), ETA(15,15), N, NP(15)
 DATA N,NP/10,6,3*7,5*10,8,5*0/
 DATA CN/0.3,0.4,0.5,0.6,0.7,0.8,0.9,1.0,1.1,1.2,5*0./
 DATA (PR(1,J)
                ,.I=1,6 )/
C1.0000 ,1.0180 ,1.0420 ,1.0576 ,1.0672 ,1.0720 /
 DATA (WAG(1,J) ,J=1,6 )/
C121.80 ,114.90 ,99.900 ,83.400 ,66.600 ,43.200 /
 DATA (ETA(1,J) ,J=1,6 )/
CO. 7559 , O. 7612 , O. 7665 , O. 7559 , O. 7251 , C. 6415 /
                ,J=1,7 )/
 DATA (PR(2,J)
C1.0000 ,1.0300 ,1.0600 ,1.0876 ,1.1128 ,1.1380 ,1.1500 /
 DATA (WAC(2, J) , J=1,7 )/
C143.40 ,135.00 ,126.60 ,116.70 ,104.70 ,91.800 ,78.300 /
 GATA (ETA(2,J) ,J=1,7 )/
C0.7559 ,0.7762 ,0.7420 ,0.7973 ,0.8026 ,0.7762 ,0.7401 /
                ,J=1,7 )/
 DATA (PR(3,J)
C1.0000 ,1.0384 ,1.0768 ,1.1200 ,1.1740 ,1.1986 ,1.2220 /
 DATA (WAC(:,J) ,J=1,7 )/
C166.80 ,161.40 ,155.10 ,145.80 ,129.90 ,120.00 ,106.80 /
 DATA (ETA(3,J) ,J=1,7 )/
CO.75J6 ,0.7762 ,0.8026 ,0.8281 ,0.8439 ,0.8281 ,0.7762 /
                ,J=1,7 )/
 DATA (PR(4,J)
C1.0000 ,1.0552 ,1.1320 ,1.1860 ,1.2400 ,1.2844 ,1.2928 /
 DATA (WAC(4,J) ,J=1,7 )/
C191.70 ,188.10 ,179.10 ,170.10 ,156.60 ,138.30 ,133.20 /
 DATA (ETA(4,J) ,J=1,7 )/
CO.7454 ,0.7762 ,0.8281 ,0.8545 ,0.8800 ,0.8281 ,0.8078 /
 DATA (PR(5,J)
                , J=1,10)/
C1.0000 ,1.0960 ,1.1776 ,1.2220 ,1.2760 ,1.3144 ,1.3264 ,
C1.3360 ,1.3660 ,1.4008 /
 CATA (WAC(5,J) ,J=1,10)/
C219.90 ,218.40 ,214.20 ,210.30 ,203.40 ,196.80 ,194.10 ,
C191.70 ,184.20 ,171.30 /
 DATA (ETA(5,J) ,J=1,10)/
Cu.7251 ,0.7762 ,0.8281 ,0.8545 ,0.8800 ,0.9011 ,0.9038 ,
C0.9011 ,0.8800 ,0.8281 /
                 ,J=1,10)/
 DATA (PR(6,J)
C1.0000 , 1.1500 , 1.2400 , 1.3000 , 1.3420 , 1.3828 , 1.4080 ,
C1. 4296 ,1. 4536 ,1.4980 /
 DATA (HAC(6,J) ,J=1,10)/
G249.91 ,249.90 ,246.60 ,242.70 ,238.20 ,233.40 ,228.30 ,
C224,10 ,216.60 ,203.40 /
 DATA (ETA(6, J) , J=1,10)/
CO.6882 ,0.7762 ,0.8281 ,0.8545 ,0.8800 ,0.9011 ,0.9108 ,
CO. 9011 , 0. 5800 , 0. 8272 /
 DATA (PR(7,J)
                 ,J=1,10)/
C1.0000 ,1.1140 ,1.2280 ,1.3288 ,1.3900 ,1.4344 ,1.4968 ,
C1.5424 ,1.5868 ,1.6000 /
 DATA (WAC(7,J) ,J=1,10)/
C283.21 ,283.20 ,283.19 ,279.90 ,276.60 ,272.40 ,264.30 ,
C254.70 ,241.80 ,237.00 /
 DATA (ETA(7,J) ,J=1,10)/
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CO.6415 , O.7251 , O.7762 , O.8281 , O.8589 , O.8800 , O.9011 ,

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CO.8800 , O.8281 , O.8175 /
                ,J=1,10)/
 DATA (PR(8,J)
C1. 0000 ,1.0660 ,1.2028 ,1.3312 ,1.4416 ,1.5100 ,1.6000 ,
C1.6420 ,1.6720 ,1.7200 /
 DATA (WAC(8,J) ,J=1,10)/
C316.81 ,316.80 ,316.79 ,316.50 ,312.90 ,308.40 ,300.00 ,
C293.40 ,288.30 ,276.60 /
 DATA (ETA(8,J) ,J=1,10)/
CO.6002 , 0.6415 , 0.7251 , 0.7762 , 0.8281 , 0.8589 , 0.8800 ,
CO.8589 , 0.8281 , 0.7867 /
 DATA (PR(9,J)
                 ,J=1,10)/
,1.7500 ,1.6720 ,1.3300 ,1.4860 ,1.6000 ,1.6720 ,1.7500 ,
C1.8004 ,1.8520 ,1.8760 F
 DATA (WAC(9,J) ,J=1,10)/
C350.12 ,350.11 ,350.10 ,350.09 ,350.08 ,349.20 ,346.80 ,
C341.70 ,333.30 ,328.20 /
 DATA (ETA(9,J) ,J=1,10)/
CO.5694 , 0.6415 , 0.7251 , 0.7762 , 0.8026 , 0.8078 , 0.8026 ,
CO.7762 ,0.7454 ,0.7251 /
 DATA (PR(10,J) ,J=1,8 )/
C1.0000 ,1.2448 ,1.4680 ,1.6000 ,1.7200 ,1.8100 ,1.8700 ,
C1.9900 /
 DATA (WAC(10,J),J=1,8 )/
C375.03 ,375.02 ,375.01 ,375.00 ,374.99 ,374.98 ,374.70 ,
C368.40 /
 DATA (ETA(10,J),J=1,8 )/
CO.5174 , 0.6415 , 0.7251 , 0.7559 , 0.7612 , 0.7506 , 0.7251 ,
CO. 6415 /
 END
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BLOCK DATA CHPDAT
      THIS IS A GENERALIZED H.P. COMP. MAP FOR UNREALISTIC SUPERSONIC EN
C
      COMMON/ COMP/CN(15), PR(15,15), WAC(15,15), ETA(15,15), N, NP(15)
      DATA N, NP/10, 2*6, 2*8, 4*10, 2*8, 5*0/
      DATA CN/.562,.674,.787,.899,1.,1.034,1.067,1.124,1.236,1.292,5+u./
      DATA (PR(1,J)
                     ,J=1,6 }/
     C1.0000 ,1.8400 ,2.4280 ,2.8690 ,3.8350 ,4.5490 /
      DATA (WAC(i,J) ,J=1,6 )/
     C51.000 ,50.200 ,49.500 ,48.800 ,46.700 ,44.500 /
      DATA (ETA(1,J) ,J=1,6 )/
     CO. 5908, 0.6218, 0.6424, 0.6527, 0.6734, 0.6424/
      DATA (PR(2,J)
                     ,j=1,6 }/
     C1. 8000 ,1. 9660 ,3.0930 ,3.9330 ,4.6890 ,5.5290 /
      DATA (WAC(2,J) ,J=1,6 ).
     C59.300 ,59.299 ,58.800 457.900 ,56.700 ,55.000 /
      DATA (ETA(2,J) ,J=1,5 )/
     CG. 5906 , O. 6424 , O. 6940 , O. 7250 , O. 7456 , O. 7250 /
      CATA (PR(3,J) ,J=1,8 )/
     C1.00CO ,1.8400 ,2.6800 ,3.4080 ,4.5210 ,5.4450 ,6.313U ,
     C6.5230 /
      DATA (EAC(3,J) ,J=1,8 )/
     C70.00.,70.000 ,69.999 ,69.500 ,68.800 ,67.900 ,66.400 ,
     C65.788 /
      DATA (ETA(3,J) ,J=1,8 )/
     CO.5857 , O.6424 , O.6837 , O.7250 , O.7774 , O.7929 , O.7774 ,
     CQ. 7697 /
      DATA (PR(4,J)
                     ,J=1,8 )/
     C1.0000 ,2.0080 ,3.4290 ,4.6050 ,5.6970 ,6.6140 ,7.5380 ,
     C7.9580 /
      DATA (WAC(4,J) ,J=1,8 )/
     C84.802,84.801,84.800,84.799,84.000,83.300,81.700,
     C80.500 /
      DATA (ETA(4,J) ,J=1,8 )/
     CO.5805 , O.6424 , O.7250 , O.7774 , O.8084 , O.8290 , O.80 4 ,
     Cu. 7929 /
      DATA (PR(5,J)
                      ,J=1,10)/
     C1.0000 ,2.519C ,3.9820 ,5.2770 ,6.4880 ,7.2020 ,8.0000 ,
     C8.5670 ,9.3860 ,9.5960 /
      DATA (WAC(5, J) ,J=1,10)/
     C101.72 ,101.71 ,101.70 ,101.69 ,101.20 ,101.00 ,100.00 ,
     C99.500 ,98.100 ,97.400 /
      DATA (ETA(5, J) , J=1,10)/
     CO.5719 ,0.6424 ,0.7250 ,0.7774 ,0.8084 ,0.8394 ,0.8600 ,
     CO.8394 , O.8084 , O.8058 /
      DATA (PR(6,J)
                      ,J=1,10)/
     C1.0000 ,2.8550 ,4.2970 ,5.6130 ,6.9360 ,7.6220 ,8.5460 ;
     C9.1340 ,9.9250 ,10.2190/
      DATA (HAC(E,J), J=1,10)/
     C108.12 ,108.11 ,108.10 ,108.09 ,107.60 ,107.10 ,106.70 ,
     C106.00 ,104.50 ,104.00 /
      GATA (ETA(\varepsilon,J) ,J=1,10)/
     CO.5702 ,0.6424 ,0.7250 ,0.7774 ,0.8084 ,0.8394 ,0.8600 ,
     CO.8394 , O.8084 , G.8041 /
      DATA (PR(7,J)
                      ,J=1,10)/
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C1.0000 ,3.2610 ,4.7590 ,6.1170 ,7.4540 ,8.3080 ,9.2180 ,

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C9.6380 ,10.513 ,10.996 /
 DATA (WAC(7,J) ,J=1,10)/
C114.52 ,114.51 ,114.50 ,114.49 ,114.48 ,114.30 ,113.60 ,
C113.30 ,112.60 ,112.40 /
 DATA (ETA(7,J) ,J=1,10)/
CQ. 5599 , 0. 6424 , 0. 7250 , 0. 7774 , 0. 8084 , 0. 8394 , 0. 8497 ,
CQ. 8394 , Q. 8084 , Q. 7981 /
                ,J=1,10)/
 DATA (PR(8,J)
C1.0000 ,1.6860 ,3.8490 ,5.4660 ,6.8660 ,8.3710 ,8.9660 ,
C9.8830 ,10.912 ,11.815 /
 DATA (WAC(8,J) ,J=1,10)/
C122.93 ,122.92 ,122.91 ,122.90 ,122.89 ,122.88 ,122.60 ,
C122.10 ,121.70 ,120.70 /
 CATA (ETA(8,J) ,J=1,10)/
CO.5392 ,0.5702 ,0.6424 ,0.7250 ,0.7774 ,0.8084 ,0.8239 ,
CO.8394 , O. 8084 , S.7774 /
 CATA (PR(9,J)
                ,J=1,8 )/
c1,0000 ,4.3530 ,7.6220 ,10.219 ,11.059 ,11.899 ,13.159 ,
C13.656 /
 DATA (WAC(9,J) ,J=1,8 )/
C139.82 ,139.81 ,139.80 ,139.74 ,139.78 ,139.50 ,139.30 ,
C139.80 /
 DATA (ETA(9,J) ,J=1,8 )/
CO.4764 , 0.6011 , 0.7250 , 0.7774 , 0.7826 , 0.7774 , 0.7250 ,
CO.6992 /
 DATA (PR(10,J) ,J=1,8 )/
C1.0000 ,3.7650 ,6.4810 ,9.1760 ,10.219 ,11.479,12.711 ,
 DATA (WAC(10,J),J=1,8 )/
G146.24 ,146.23 ,146.22 ,146.21 ,146.20 ,146.19 ,146.18 ,
C146.17 /
 DATA (ETA(10,J),J=1,6 )/
CO. 4661 ,0.5702 ,0.6424 ,0.7250 ,0.7508 ,0.7508 ,0.7250 ,
C3.6424 /
 END
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BLOCK DATA LTURB
 THIS IS A GENERALIZED L.P. TURBINE MAP
 COMMON/ LTURE/TFF(15), CN(15,15), OH(15,15), ETA(15,15), N, NP(15)
 DATA N,NP/11,9*15,12,9,4*0/
 DATA TFF/ 88.470, 102.80, 116.84, 129.33, 141.05, 145.73, 15u.dd,
                                      4+0./
   153.35, 156.41, 159.78, 163.17,
 JATA ( CN( 1,J),J=1,15)/
CG. 3682, 0.5336, 0.7365, 0.9754, 1.2146, 1.4173, 1.6201, 1.7673,
C2.0247, 2.2827, 2.4665, 2.6137, 2.8166, 2.9456, 3.3138/
 DATA ( DH( 1,J),J=1,15)/
CO.0010, O.0026, O.0035, O.0044, O.0051, O.0056, O.0059, O.0061,
CO.0062, 0.0061, 0.0057, 0.0053, 0.0044, 0.0035, 0.0001/
 DATA (ETA( 1,J),J=1,15)/
CO.7120, 0.7300, 0.7472, 0.7300, 0.7140, 0.7000, 0.6850, 0.6730,
CO.6452, O.6200, O.6000, O.5750, O.5310, O.5000, O.3850/
 DATA ( CN( 2,J),J=1,15)/
CO.3682, O.5518, O.7919, 1 D672, 1.2682, 1.4446, 1.6937, 1.8954,
C2.0619, 2.2273, 2.3747, 2.6229, 2.8720, 3.0555, 3.3138/
 DATA ( DH( 2,J),J=1,15)/
C0.0026, 0.0039, 0.0054, 0.0069, 0.0080, 0.0087, 0.0096, 0.0101,
CO.0104, 0.0107, 0.0108, 0.0106, 0.0101, 0.0094, U.0077/
 DATA (ETA! 2,J),J=1,15)/
CO.8000, 0.8100, 0.8200, 0.8300, 0.8300, 0.8290, 0.8100, 0.8000,
CO.7850, O.7600, O.7450, O.7000, O.6800, O.6450, O.5900/
 DATA ( CN( 3,J),J=1,15)/
CO. 3682, 0.5911, 0.8655, 1.0764, 1.2519, 1.4354, 1.6201, 1.8409,
C2.0247, 2.2455, 2.4302, 2.5956, 2.7791, 3.0555, 3.3138/
 DATA ? DH( 3,J),J=1,15)/
C 0. 0031, 0. 0051, 0.0071, 0.0087, 0.0099, 0.0111, 0.0122, 0.0134,
CO. 0143, 0.0152, 0.0157, 0.0162, 0.0166, 0.0167, U.0164/
 DATA (ETA( 3,J),J=1,15)/
CO.8900, O.8300, O.8600, O.8630, O.8670, O.8700, O.8720, O.8720,
CU.8700, 0.8670, 0.8600, 0.8500, 0.8300, 0.8000, 0.7600/
 DATA ( CN( 4,J),J=1,15)/
CO.3682, O.4237, O.6810, O.8837, 1.1047, 1.2882, 1.5090, 1.7482,
C2.0429, 2.2091, 2.3747, 2.6047, 2.8720, 3.1291, 3.3138/
 DATA ( DH( 4,J),J=1,15)/
00.0033, 0.0038, 0.0061, 0.0078, 0.0096, 0.0110, 0.0126, 0.0141,
CO. 0159, 0.0166, 0.0174, 0.0183, 0.0191, 0.0195, 0.0197/
 DATA (ETA( 4,J),J=1,15)/
C0.7995, 0.8000, 0.8400, 0.8600, 0.8680, 0.8730, 0.8800, 0.8830,
CO.8835, 0.8830, 0.8800, 0.8740, 0.8600, 0.8350, 0.8200/
 DATA ( CN( 5,J),J=1,15)/
CO.3682, 0.5065, 0.7365, 0.9754, 1.2882, 1.5647, 1.7301, 1.9690,
C2. 0983, 2.2637, 2.4332, 2.6691, 2.9456, 3.1846; 3.3138/
 DATA ( DH( 5,J),J=1,15)/
C 0. Q 0 3 6, 0. Q 0 4 9, 0. Q 0 7 1, 0. Q 0 9 2, Q 0. Q 1 1 9, Q 0. Q 1 4 1, Q 0. Q 1 5 5, Q 0. Q 1 7 2,
CG. 0181, 0.0192, 0.0202, 0.0214, 0.0226, 0.0235, 0.0239/
 DATA (ETA( 5,J),J=1,15)/
CO.7750, O.8000, O.8480, O.8600, O.6750, O.8900, O.8912, O.8940,
CG. 8955, 0.8970, 0.8961, 0.8900, 0.8790, 0.8671, 0.8600/
 DATA ( CN( 6,J),J=1,15)/
CO. 3682, O. 6164, O. 6372, 1.1047, 1.2882, 1.5283, 1.7482, 1.9509,
C2.2133, 2.4302, 2.6510; 2.8619, 3.1384, 3.2584, 3.3138/
 DATA ( DH( 6,J),J=1,15)/
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CQ.0038, 0.0064, 0.0087, 0.0113, 0.0130, 0.0152, 0.0171, 0.0187,
CO. 0209, 0. 0226, 0.0244, 0.0259, 0.0286, 0.0303, 0.0319/
 DATA (ETA( 6,J),J=1,15)/
CG.7600, G.8000, G.8450, O.8600, O.8730, O.8900, O.8950, O.9000,
CO.9005, 0.9010, 0.9004, 0.9000, 0.8900, 0.8800, 0.8735/
 DATA ( CN( 7,J),J=1,15)/
CO. 3682, O. 7728, 1.0129, 1.2659, 1.4729, 1.6785, 1.8409, 2.0247,
C2.1901, 2.3000, 2.3929, 2.5038, 2.5583, 2.6137, 2.6319/
 DATA ( DH( 7,J),J=1,15)/
C0.0044, 0.0089, 0.0115, 0.0141, 0.0162, 0.0181, 0.0197, 0.0216,
C 0. 0235, 0. 0250, 0.0265, 0.0284, 0.0296, 0.0314, 0.0329/
 CATA (ETA( 7,J),J=1,15)/
CO.7310, O.8000, O.8300, O.8600, O.8750, O.8900, O.8930, O.8975,
CO.8999, O.9000, O.8980, D.8937, O.8900, O.8799, O.8710/
 DATA ( CN( 8,J),J=1,15)/
C0.3682, 0.6072, 0.7919; 0.9754, 1.2337, 1.4548, 1.6383, 1.8409,
C1.9509, 2.0801, 2.1537, 2.2091, 2.2637, 2.3009, 2.3051/
 DATA ( DH( 8,J),J=1,15)/
CO.0048, 0.0078, 0.0102, 0.0124, 0.0153, 0.0177, 0.0201, 0.0226,
C 0. 0242, 0. 0261, 0.0274, 0.0285, 0.0299, 0.0314, 0.0321/
 DATA (ETA( 8,J),J=1,15)/
CQ.71QQ, Q.745Q, Q.768Q, Q.8QQQ, Q.838Q, Q.86QQ, Q.8712, Q.878Q,
CO.8600, 0.8775, 0.8760, 0.8722, 0.8660, 0.8600, 0.8480/
 DATA ( CN( 9,J),J=1,15)/
CO. 3682, O. 5518, O. 6629, O. 8282, 1.0129, i.1691, 1.2337, 1.3809,
C1.5283, 1.6201, 1.7482, 1.8409, 1.8954, 1.9147, 1.9237/
 CATA ( DH( 9,J),J=1,1,5)/
CO.0054, 0.0080, 0.0096, 0.0119, 0.0141, 0.0160, 0.0169, 8.0188,
CO.0209, 0.0223, 0.0244, 0.0263, 0.0279, 0.0289, 0.0303/
 DATA (ETA( 9,J),J=1,15)/
CQ.6780, 0.7000, 0.7125, 0.7350, 0.7690, 0.8000, 0.8060, 0.8225,
CG. 6395, 0.8450, 0.8470, 0.8445, 0.8330, 0.8235, 0.8080/
 DATA ( CN(10,J), J=1,12)/
CO. 3682, 0.4782, 0.6447, 0.7546, 0.8655, 0.9754, 1.1047, 1.2015,
C1.2701, 1.3073, 1.3365, 1.3407/
 GATA ( DH(1.0, J), J=1, 12) /
CG. 0061, 0.0078, 0.0104, 0.0122, 0.0139, 0.0157, 0.0181, 0.0201,
CO. 0217, 0. (230, 0.0244, 0.0251/
 DATA (ETA(1.0, J), J=1,12)/
Cu. 6380, 0.6550, 0.6700, 0.6850, 0.7000, 0.7110, 0.7180, 0.7180,
C9.7170, 0.7140, 0.7000, 0.6890/
 DATA ( CN(11, J), J=1,9 )/
CU. 3682, U. 4418, U. 5518, U. 6447, U. 7365, U. 6282, U. 8837, U. 9391,
Cu. 9715/
 DATA ( DH(::1,J),J=1,9 )/
CO. 0069, 0.1086, 0.0106, 0.0123, 0.0141 · 0.0159, 0.0172, 0.0186,
CO. 0201/
 DATA (ETA(11,J),J=1,9 )/
Cu. 6000, 0.6000, 0.6120, 0.6170, 0.6210, 0.6258, 0.6250, 0.6230,
C0.6009/
 END
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BLOCK DATA ITURE
 THIS IS A GENERALIZED I.P. TURBINE MAP
 COMMON/ ITURE/TFF(15), CN(15,15), OH(15,15), ETA(15,15), N,NP(15)
 DATA N, NP/11,9*15,12,9,4*0/
 DATA TFF/ 39.670, 82.236, 93.468, 103.464, 112.836, 116.584,
1 120.000, 122.68, 125.12, 127.82, 130.536,
 DATA ( CN( 1,J),J=1,15)/
CO. 3522, O. 5194, O. 7044, O. 9330, 1.1618, 1.3556, 1.5497, 1.6905,
C1. 9367, 2. 1835, 2. 3593, 2. 5001, 2. 6941, 2. 8175, 3. 1698/
 GATA ( DH( 1,J),J=1,15)/
CO. 0016, 0.0023, 0.0031, 0.0038, 0.0045, 0.0049, 0.0052, 0.0054,
C0.0055, 0.0054, 0.0051, 0.0047, 0.0038, 0.0031, 0.0001/
 DATA (ETA( 1,J),J=1,15)/
CQ.712Q, Q.73QQ, Q.7472, Q.73QQ, Q.714Q, Q.7QQQ, Q.665Q, Q.673u,
CO.6452, O.6200, O.6000, O.5750, O.5310, O.5000, U.3850/
 DATA ( CN( 2,J),J=1,15)/
CO.3522, O.5278, O.7575, 1.0208, 1.2322, 1.3818, 1.6201, 1.8130;
C1. 9723, 2.1305, 2.2715, 2.5089, 2.7471, 2.9227, 3.1698/
 DATA ( DH( 2,J),J=1,15)/
CO.0023, 0.0035, C.0047, 0.0961, 0.0070, 0.0076, 0.0084, 0.0089,
CO.0092, 0.0094, 0.0095, 0.0093, 0.0089, 0.0083, 0.0068/
 DATA (ETA( 2,J),J=1,15)/
CO.8000, O.8100, O.8200, 5.8300, O.8300, O.8290, O.8100, O.8000,
CC.7830, 0.7600, 0.7450, 0.7000, 0.6800, 0.6450, 0.5900/
 DATA ( CN( 2,J),J=1,15)/
CO.3522, O.5654, O.8279, 1.0296, 1.1975, 1.3730, 1.5497, 1.7609,
C1. 9367, 2.1479, 2.3245, 2.4827, 2.6583, 2.9227, 3.1698/
 DATA ( DH( 2,J),J=1,15)/
CO.0027, 0.0045, 0.0063, 0.0076, 0.0087, 0.0098, 0.0107, 0.0118,
CO.0126, 0.0134, 0.0139, 0.0142, 0.0146, 0.0147, 0.0145/
 DATA (ETA( 2,J),J=1,15)/
CO. 8000, O. 8300, O. 8600, O. 8630, O. 8670, O. 8700, O. 8720, O. 8720,
CO.8700, 0.8670, 0.8600, 0.8500, 0.8300, 0.8000, 0.7600/
 CATA ( CN( 3,J),J=1,15)/
CO. 3522, 0.5654, 0.8279, 1.0296, 1.1975, 1.3730, 1.5497, 1.7609,
C1. 9367, 2.1479, 2.3245, 2.4827, 2.6583, 2.9227, 3.1698/
 GATA ( DH( 3,J),J=1,15)/
CO.0027, 0.0045, 0.0063, 0.0076, 0.0087, 0.0098, 0.0107, 0.0118,
CO. 0126, 0.0134, 0.0139, 0.0142, 0.0146, 0.0147, 0.0145/
 DATA (ETA( 3,J),J=1,15)/
CO.8000, 0.8300, 0.8600, 0.8630, 0.8670, 0.8700, 0.8720, 0.8720,
C0.8700, 0.8670, 0.8600, G.8500, 0.83CG, 0.80O0, 0.76QQ/
 DATA ( CN( 4,J),J=1,15)/
C0.3522, 0.4052, 0.6514, 0.8452, 1.0567, 1.2322, 1.4434, 1.6722,
C1. 9540, 2.1131, 2.2715, 2.4915, 2.7471, 2.9931, 3.1698/
 DATA ( DH( 4,J),J=1,15)/
CO.0029, 0.0034, 0.0054, 0.0069, 0.0084, 0.0097, 0.0111, 0.0124,
CO. 0140, 0.0146, 0.0153, 0.0161, 0.0168, 0.0172, 0.0173/
 DATA (ETA( 4,J),J=1,15)/
CO.7995, C.8000, U.8400, O.8600, Q.8680, O.8730, O.8800, D.8830,
CJ. 8835, 0.8830, 0.8800, 0.8740, J.8600, 0.8350, 0.8200/
 DATA ( CN( 5,J),J=1,15)/
CO.3522, O.4844, O.7044, O.933O, 1.2322, 1.4967, 1.6548, 1.8834,
C2. 0071, 2.1652, 2.3274, 2.5531, 2.8175, 3.0461, 3.1698/
 DATA (DH(5,J),J=1,15)/
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CQ. 9031, 0.0043, 0.0062, 0.0081, d.0105, 0.0124, 0.0136, 0.0152,
CO. 0159, 0.0169, 0.0178, 0.0189, 0.0199, 0.0207, 0.0210/
 DATA (ETA( 5,J),J=1,15)/
Cú.7750, 0.8000, 0.8480, 0.860C, 0.8750, 0.8900, 0.8912, ú.8940,
CQ.8955, Q.8970, Q.8961, Q.8900, U.8790, Q.8671, Q.8600/
 DATA ( CN( 6,J),J=1,15)/
CQ. 3522, Q. 5896, Q. 8008, 1.0567, 1.2322. 1.4619, 1.6722, 1.86EU,
C2.1171, 2.3245, 2.5357, 2.7375; 3.0019; 3.1167, 3.1698/
 DATA ( DH( 6,J),J=1:15)/
CQ. 0034, Q. 0057, 0.3076, 0.0100, 0.0114, 0.0134, 0.0150, 0.0165,
CO.0184, 0.0199, 0.0214, 0.0228, 0.0251, 0.0267, 0.0290/
 OATA (ETA( 6,J),J=1,15)/
CO.7680, O.8000, O. +50, O.8690, O.8730, O.8900, O.8950, O.8000,
CO.9005, 0.9010, 0.9004, 0.9000, 0.6900, 0.6800, 0.8710/
 DATA ( CN( 7,J),J=1,15)/
CO: 3522, 0.7392, 0.9689, 1.2109, 1.4089, 1.6056, 1.7609, 1.9367,
C2. 0948, 2.2000, 2.2689, 2.3949, 2.4471, 2.5001, 2.5175/
 DATA ( DH( 7,J),J=1,15)/
CG. 0038, 0.0078, 0.0101, 0.0124, 0.0142, 0.0159, 0.0173, 0.0190,
CO.0207, 0.0220, 0.0233, 0.0250, 0.0261, 0.0276, 0.0290/
 DATA (ETA( 7,J),J=1,15)/
CO,7310, 0.6000, 0.8300, 0.8600, 0.8750, 0.8900, 0.8930, 0.8975,
CO.8999, O.9000, O.8980, O.8937, O.8900, O.8799, O.8710/
 DATA ( CN( 8,J),J=1,15)/
CQ. 3522, Q.58Q8, Q.7575, Q.933Q, 1.18Q1, 1.3915, 1.5671, 1.76Q9,
C1.8660, 1.9897, 2.0601, 2.1131, 2.1652, 2.2009, 2.2048/
 DATA ( DH( 8,J), J=1,15)/
CO.0042, 0.0069, 0.0090, 0.0109; 0.0135, 0.0156, G.0177, 0.0199,
C 0. 0213, 0. 0230, 0.0241, 0.0251, 0.0263, 0.0276, 0.0283/
 DATA (ETA( 8,J),J=1,15)/
CO.7100, 0.7450, 0.7680, 0.8000, 0.8380, 0.8600, 0.8712, 0.8780,
CO.8800, O.8775, O.8760, O.8722, O.8660, O.8600, O.8480/
 DATA ( CN( 9,J), J=1,15)/
CO.3522, U.5278, U.6340, U.7922, U.9689, 1.183, 1.1801, 1.3209,
C1.4619, 1.5497, 1.6722, 1.7609, 1.8130, 1.8315, 1.8481/
 DATA ( DH( 9,J),J=1,15)/
CO. 0047, 0.0070, 0.0084, 0.0104, 0.0124, 0.0141, 0.0148, 0.0156,
CO. 0184, 0.0196, 0.0214, 0.0232, 0.0245, 0.0255, 0.0267/
 DATA (ETA( 9,J),J=1,15//
co.6780, 0.7000, 0.7125, 0.7350, 0.7690, 0.8000, 0.8060, 0.8225<sub>°</sub>
CO.8395, G.8450, G.8470, C.8445, G.8330, G.8235, D.8080/
 DATA ( CN(10, J), J=1,12)/
CO. 3522, 0.4574, 0.6167, 0.7218, 0.8279, 0.9330, 1.8967, i.1493,
C1.2148, 1.2505, 1.2784, 1.2824/
 (ATA ( BH(10,J),J=1,12)/
CG.9054, 0.9U65, G.0092, D.0107, O.0123, O.0138, O.0159, O.9177,
CO. 0191, 0. 0202, 0.0214, 0.0221/
 CATA (ETA: 10, J), J=1, 12)/
CG.6380, G.6550, O.670G, O.6850, O.7UOG, O.7110, O.7180, O.7180,
C 0. 7170, 0.7140, 0.7000, 0.6890/
 DATA ( CN(11,J),J=1,9 )/
CQ.3522, Q.4226, Q.5278, Q.6167, Q.744%, Q.7422, U.8452, Q.8983,
C0.9293/
 DATA { DH(11,J), (=1,9 )/
Q0.0661, 0.0075, 0.0093, 0.0108, 0.0124, 0.0140, 0.0151, 0.5164,
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C0.0177/
DATA (ETA(11,J),J=1,9)/
C0.6000, 0.6000, 0.6126, 0.6170, 0.6210, 0.6258, 0
END

END DATA (ETA(11,J),J=1,9 )/ C0.6000, 0.6000, 0.6120, 0.6170, 0.6210, 0.6258, 0.6250, 0.6230,

```
BLOCK DATA HTURB
 THIS IS A GENERALIZED H.P. TURBINE MAP
 COMMON / HTUR8/TFF(15), CN(15,15), CH(15,15), ETA(15,15), N, NP(15)
 DATA N, NP/10, 9*15, 12, 5*0/
 DATA TFF/ 39.670, 42.990, 47.460, 48.610, 49.175, 49.600,
   50.000, 50.425, 50.920, 51.575,
 DATA ( CN( 1, J), J=2, 15)/
CO, 1872, 0.3372, 9.5156, 0.7128, 0.9382, 1.1442, 1.3138, 1.5382.
C1.7264, 1.9324, 2.1508, 2.4058, 2.5892, 2.7862, 2.9460/
 DATA ( DH( 1,J),J=1,15)/
CO.0032, 0.0057, 0.0084, 0.0108, 0.0133, 0.0152, 0.0164, 0.0174,
C0.0179, D.0176, 0.0167, 0.0144, 0.0120, 0.0082, 0.0034/
 DATA (ETA( 1,J),J=1,15)/
CO.6219; D.7078, D.7868, D.809D, Q.809D, D.7963, B.7779, D.7422,
CO.7078, D.7635, C.6058, D.5309, D.4773, D.4045, D.3034/
 DATA ( CN( 2,J),J=1,15)/
C0.1872, 0.3942, 0.5814, 0.7128, 0.8442, 0.9804, 1.1068, 1.2794, C1.4450, 1.7868, 1.9696, 2.2796, 2.6970, 3.8960, 3.3774/
 DATA ( DH( 2,J),J=1,15}/
CO.0036, 0.0080, 0.0113, 0.0136, 0.0156, 0.0175, 0.0192, 0.0212,
CQ. 0228, 0.0248, C.0260, 0.0261, 0.0241, 0.0188, Q.0128/
 DATA (ETA( 2,J),J=1,15)/
CO.6068, 0.7078, 0.8090, 0.8292, 0.8363, 0.8393, 0.8366, 0.8302,
CO. 8254; 0.8090, 0.7695, 0.7078, 0.6068; 0.5056, 0.4197/
 DATA ( CN( 3,J),J=1,15)/
CG. 1872, G. 4362, G. 6568, G. 8726, 1.0696, 1.7382, 1.4638, 1.6882,
C1. 9696, 2.2138, 2.5520, 2.8650, 3.8392, 3.2548, 3,3774/
 DATA ( DH( 3,J),J=1,15)/
CO.0046, 0.0100, 0.0144, 0.0184, 0.0216, 0.0240, 0.0268, 0.0292,
CO. 0316, 0. 0331, 0.0344, 0.0346, 0.0346, 0.0324, 0.0312/
 DATA (ETA( 3,J),J=1,15)/
C0.5764, 0.7078, 0.8090, 0.8494, 0.8543, 0.8515, 0.8494, 0.8409, C0.3262, 0.8090, 0.7579, 0.7078, 0.6652, 0.6068, 0.5865/
 DATA ( CN( 4,J),J=1,15)/
CO.1872, O.2550, O.4784, D.6942, O.9148, 1.1442, 1.3862, 1.5618,
C1.8010, 1.9794, 2.2794, 2.5%38, 2.8334, 3.1422, 3.3774/
 DATA ( BH( 4,J),J=2,15)/
CO.0052, 0.0068, 0.0120, N.8164, O.9204, O.8244, G.0280, B.8384,
CO.0336; 6.0356; 0.0388; 0.3412, 0.0441, 0.0472, 0.0494/
 DATA (ETA( 4,J),J=1,15)/
C0.5643, 0.6068, 0.7078, 0.8190, 0.8494, 0.8596, 0.8596, 0.8575, C0.8535, 0.9494, 0.8363, 0.8262, 0.8090, 0.7797, 0.7584/
 DATA ( CN( 5,J),J=1,15//
CO.1872, 6-3600, 6,5254, 0.7500, 0.9754, 1,2754, 1.4824, 1.7638,
C2.9450, 2.3362, 2.6450, 2.8702, 5.0764, 3.1520, 3.1618/
 QATA ( DHC 5,J),J=1,15%/
CA. 0056, 0. 9088, 0.0144, 0.9192, 9.0236, 8.0288, 0.2321, 0.0360,
00.0400, 0.0444, 0.0496, 0.0540, 0.0596, 0.0640, 0.0661/
 DATA (ETA( 5,J);J=1,15)/
C 0. 5562, 0. 6068, 0. 7076, C. 8090, 0. 8494, 0. 8697, 0. 8696, 0. 8662,
Cu. 8615, G. 8555, G. 8528, D. 8494, G. 8494, G. 8532, G. 6570/
 DATA ( CN( 6,J),J=1,15)/
CO. 1872, 0.3568, C.6196, O.8628, 1.0932, 1.2552, 1.5010, 1.6882,
C1. 9138: 2.1246; 2.2756, 2.4226, 2.4959, 2.5372, 2.5558/
```

DATA ( DH( 6,J),J=1,15)/

```
CO.0068, 0.0120, 0.0192, 0.0252, 0.0300, 0.0340, 0.0384, 0.0421,
C 0. 0472, 0. 0524, 0.0564, 0.0668, 0.0640, 0.0668, 0.0693/
 CATA (ETA( 6,J),J=1,15)?
ċJ.5309, O.€O68, O.7078, O.8090, Q.8494, O.8697, J.8819, ù.8899,
CO.8940, O.8969, O.8975, D.8937, O.8968; O.8937, O.8896/
 DATA ( CN( 7, 1), 1=1,15)/
CO. 1872, O. 4314, O. 6844; O. 9568, 1.2010, 1.3834, 1.5108, 1.5186,
C1.7450, 1.8618, 1.9558, 2.0060, 2.0450, 2.0824, 2.1010/
 DATA ( DH4 7,J),J=1,15)/
CO.0080, 0.0164, 0.0236, 0.0308, 0.0372, 0.0416, 0.0448, 0.0476,
CO. 0510, 0.0544, 0.0576, 0.0600, 0.0624; 0.0660, C.0700/
 DATA (ETA( 7,J),J=1,15)/
CO. 5062, 0.6068, 0.7078, 0.8090, 0.8494, 0.8697, 0.8797, 0.8899,
CO.8954, 0.5000; 0.9010, 0.9000, 0.8980, 0.8925, 0.8793/
 DATA ( CN( 8,J),J=1,15)/
CO. 1872, O. 4834, O. 7314, O. 8814, 1.0226, 1.1442, 1.2804, 1.3696,
C1.4638, 1.5950, 1.6746, 1.7450, 1.8810, 1.8156, 1.8196/
 CATA ( DH( 8,J),J=1,15)/
CJ. 0088, 0.0196, 0.0272, 0.0316, 0.0356, 0.0392, 0.0432, 0.0460,
CG. 0488, 0.0528, 0.0560, 0.0596, 0.0640, 0.0664, 0.0693/
 DATA (ETA( 8,J), J=1,15) /
Cd.5051; U.6068, G.7078, O.7665, O.8090; O.8292, U.8494, O.8596,
CO.8697, Q.8808, Q.8848, Q.8848, Q.8788, Q.8697, Q.8590/
 DATA ( CN( 9,J),J=1,15)/
CO. 1872, 0.3372, 0.5344, 0.6754, 0.8C68, 6.9196, 1.0128, 1.1254,
C1.2196, 1.3138, 1.3696, 1.4068, 1.4450, 1.4638, 1.4676/
 DATA ( DH( 9,J),J=1,15)/
CO. 30 93, 0. 0159, 0. 0232, 0. 0284; 0. 0330; 0. 0358, 0. 0400, 0. 0442,
CC.0480, D.0524, D.0556, N.0580, D.0612, D.0640, D.7668/
 [ATA (EYA( 9,J),J=1,15)/
CO. 4909, 0.5380, 0.6068, 0.6573, 0.7078, 0.7463, 8.7776, 0.0090,
CO.8191, 0.8392, 0.8347, 0.8363, 0.8322, 0.8241p S.8890/
 DAYA ( CN(10,J),J=1,12)/
CO.1872, 0.2814, 0.3804, 0.4686, 0.5628, 0.6382, 0.6892, C.7362,
C0.7696, 0.8068, 0.8254, 0.8304/
 CATA ( DH(10,J),J=1,121/
C 0. 0132, 0-0180, 0.0228, 0.0268, 0.0314, 0.0352, 0.9380, 0.9412,
CO. 0440, 0.0476, 0.0504, 0.0530/
 OATA (ETA(10,J),J=1,12;/
CG. 4257, G. 4747, D. 5056, O. 5359, D. 5683, O. 5941, O. 6.78, O. 6178,
C0.6240, 0.6310, 0.6265, 0.6118/
 END
```

## SECTION VIII

## SAMPLE INPUT LISTING

The first section of data cards is the set of variables selected for output (controlled output). The second section is the Namelist input for running the desired points. The Namelist input consists of the following points: design point at sea-level static, a setup case for sea-level static afterburning, a sea-level static full afterburning point, several points in a subsonic power hook, a setup case for supersonic afterburning, and the supersonic full afterburning point.

T35 P55 T24 024 WAn W=0 W524 FAR?4 T25 P25 DPDUC ETAP AMEF A455 ETAF ETAI ETAL ETATHE ETATIF ETATLE TS 96 PSF 446 ٧5 WGG T7 WEA FART ETAA DONET PSR 443 V 8 PS9 A49 **V**9 **5**258 AMER **V28 B**25c AMEC A50 BYEASS HPEXT WFT WGT V٩ FRD CVMNOZ VJM CVOMOZ NJD FGM

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THEEND
 SDATAIN ITTTLE=1, TDES=1, TDUMP=1, TAMTP=0, MODE=3,
 IGASMY=2,T400=1,0955=2.0,A455=0.00,AM6=0.24,HD5YT=0.,MCZFLT=0,
ITRYS=200., TOLALL=.005, ZFDS=0.8333, ZTDS=0.8143, ZCDS=0.8143,
PCNFDS=100.,ETAFDS=0.839,PCNIDS=100.,ETAIDS=0.853,PCNCPS=100.,
 ETACOS=0.653,DPCODS=0.047,DPOUDS=0.05,NTCODS=1250.,ETA8CS=0.9875,
 PRFDS=2.2,PRIDS=3.435,PRODS=7.435,MAFDS=354.,MAIDS=109.,
 TrHPDS=50.0,CNHPDS=2.0,ETHPDS=0.881,TFIPDS=120.,CNIPDS=2.2,ETIPDS=.881,
 TFLPDS=130.0,CNLPDS=2.3,FTLPDS=0.917,DPAFDS=0.0,CVMN0Z=0.989,
 DELFG=1.0,DELFN=1.0,DELSFG=1.0,908LF=0.0,PC8LI=0.0,PC8LC=0.0,
 T4DS=2860., AM=0.0, ALTD=0.03
      SLS TRISPL DESIGN POINT
 $DATAIN MODE=0, T4=2860., ITITLF=1*
      SETUP FOR SLS AFTERRURNING
 SDATAIN T4=2860., IAFTBN=1, T7=3700., ETAA=0.875, ITITLE=19
      SLS FULL AFTERBURNING
 $DATAIN MODI=3,PCNF=99.0,AM=0.75,ALTP=25000.,ITIT%5=1$
      SUBSONIC POWER HOOK
 SDATAIN PCNF=90.5
 SDATAIN PONF=80.5
 SDATAIN PONF=70.5.
 CDATAIN MODE=1, PONCHIND., AM=1. 0, ALTP-50000, TTTTLE-10
      SETUR FOR RUPERSONIS AFTER FURNING
 SDATAIN PONC=100., IAFTBN=1, T7=3700., TTAA=0.85, TTITLE=1.5
      SUPERSONIC FULL AFTERBURNING
 SDATAIN IE'D=15
```

## SECTION IX

## SAMPLE OUTPUT LISTING

The following are typical computer printouts, the first point is the design point and includes a page of correction (or scaling) factors and a page of values of variables in common. The other operating points consist of a page of output for each point. Not included for these points is a common dump, which follows each output page and is very similar to the common dump following the design point correction factors.

			INTOS 1				
FAN DESIGN	PRFCF=	.30001200E+01 ETAFCF=	F= .95341519E+00	MAFCF=	.589995716+0J	120S=	•5186682GE+03
I.P. COMPRESSOR DESIGN	FR ICF=	.41531922E+01 ETAICF=	F= .97287007E+00	WAICF	.18565113E+00	T210S=	.67476966E+03
H.P. COMPRESSOR DESIGN	PRCCF=	.34767092E+00 ETACCF=	F= .991868725+00	MACCF	.1985785E+00	T220S=	.10024498E+04
COMBUSTOR DESIGN	WA3 CDS=	*16833805E+02 ETABCF=	F= .98750000E+00	<b>ETCOCF</b> ≖	.89568386E+00		
H.P. TURBINE DESIGN	CNHPCF=	.10695794E+01 TFHPCF=	:F= .30748997E+01 ETHPCF=	ETHPCF=	.97888888E+88 DNHPCF=	DHHPCF=	.67280169E+60
I.P. TURBINE DESIGN	CNI PCF=	.10953379E+01 TFIPCF=	F= .38446973E+01 ETIPGF=	ETIPCF=	.9766669E+00 OHIPCF=	OHIPCF=	.14359988E+01
L.P. TURBINE DESIGN	CN. PCF=	.10820381E+01 TFLPCF=	;F= .25251660E+01 ETLPCF=	ETLPCF=	*10394036E+01 OHLPCF=	OHLPCF=	.31564692E+01
DUCT DESIGN	WA23DS≠	.25046259E+04					
TURBINE/DUCT AREA DESIGN	N A55=	.18460091E+01 AM	AMS5= .65168846E+00	A25=	A25= .64758021E+01	AH25=	.25239827E+00
GFT ERBURNER ENTRANCE DESIGN ARE	SIGN AREA	A6 11.620					
AFTERBURNER DESIGN	# G6 CD S=	.51899812E+04					
NOZ ZLE DESIGN	A 8=	.46147586E+01 A	AM6= .10000080E+01	¥6¥	A9= .46825091E+01	AN9=	AH9= :11367079E+01
MAIN SHOCK OUTSIDE C-D NOZZLE	NO 22 LE	FG= 17454.88	L.	FN= 17454.88	8	SFC=	. 52412

	E+00 .100000E+03 .286000E+04	E+01 .100000E+01 .100000E+01 E+01 .953415E+00 .589996E+00 E+01 .972670E+00 .185851E+00 E+00 .991869E+00 .98679E+00 E+00 .672802E+00 .96770E+00 E+01 .43600E+01 .674770E+03 E+01 0 .00 0 0 0 E+01 0 0 0 0 0	E+01 .123918E+03 .159103E+01 E+02 .74496E+03 .161215E+01 E+02 .774590E+03 .162875E+01 .00 .163992E+01 .00 .108000E+03 .00 .110541E+03 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00	E+01 0. 0. 0. 161362E+01 0. 160362E+01 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.	E+01 .161305E+03 .160362E+01 .100000E+01 0. E+01 .254240E+03 .170844E+01 E+01 .254240E+03 .170844E+01 E+01 .257516E+04 .319137E+03 E+03 .240000E+00 .252398E+00 E+05 0.
	1E+03 .814300E+00	.100000E+01 1E+03 .30012E+01 1E+03 .445319E+01 1E+03 .347871E+0 1E+02 .47000E=01 1E+01 .978889E+00 1E+01 .978889E+00 1E+01 .500000E=01 1E+04 .500000E=01 1E+04 .68251E+01	16+03 .100008E+01 -755700E+01 -247383E+02 -647363E+02 -647363E+02 -647363E+02 -647363E+01 -647363E+01 -647363E+01 -647363E+01 -6473626E+01 -6473626E+01 -6473626E+01 -6473626E+01 -6473626E+01 -6473626E+01 -6473626E+01 -6473626E+01 -6473626E+01	6+03 .160810E+01 1E+03 .209100F+01 0. 0. 00E-01	1E+03 .209000E+01 5E+04 .222336E+01 5E+04 .222336E+01 0 .222336E+01 0 .222336E+01 1E+01 .375176E+03 1E+04 .174549E+05
	.814300E+00 .100000E+03	.286000E+04 0354000E+03 .355000E+03 .3550000E+03 .550063E+04 .550000E+03 .5500000E+03 .5500000E+03 .5500000E+03 .5500000E+03 .5500000E+03 .5500000E+03 .5500000E+03 .5500000E+03 .550000000000000000000000000000000000	.159103E+01 .518660E+03 -160410E+01 .100245E+04 -162430E+01 .286000E+04 -184603E+01 .221324E+04 -184603E+01 .221324E+04 -301279E+03 .35400E+03 -115453E+03 .106000E+03 -155590E+02 .106000E+03 -130300E+03 .106000E+03 -130300E+03 .34300E+03 -130300E+03 .34300E+03 -130300E+03 .34300E+03	.100000E+03 0. .220000E+01 .161385E+03 .160362E+01 0. 0.	.184603E+01 .674770E+03 .170844E+01 .104745E+04 .170844E+01 .104745E+04 .717850E+02 0. .100000E+01 .013745E+01
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	. 13 00000 003	. 230000E+01	. 542121E-61	.1159852+03	.179758E+04	.262349E+61
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MAIN SHOCK OUTSIDE C+G KGZZLE	d rozzle	FG = 33437.20		FW= 31417.20		SPER Z. 45453

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.786993E+02	. 321475E-01	. 220905E+01	. 12016EE+03	
OHAL INCHES	CHICIP	• 196515E • 02 CNIP	• 30 UCS UE + UC TFFIP	
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	•	<b>°</b> •	ģ		. 2535 195+ 04	,115277E+02
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	. 50014JE+02	.199325E+01	* 4542435-01	. 1013088+03	. 216052E+04	.550675E+01
	TFFIP	CMID	DHTCIP	17.40	15.	ps
	. 12#217E+03	. 215719E+01	.312377E-01	.6757036+02	.192572E+04	•320299E+01
	1F FL P	CALP	DHTCLP	CHTF	155	P55
	. 12 97 025 + 0.3	. 221916E+01	.527765E-01	. 1016245+03	.156240E+04	.125485E+01
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		V23	PSSS	AH29	V29	BYPASS
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	HPEXT.	***	101	X	TRO	CVMNOZ
	·•a	. 105665E+01	. 287354E+03	.762422E+83	· 441 + 65E+ 04	.960800E+00
	2	CADACS	D5>	TO.	F.C.	A55
	1468516+04	, 	ð	· 850431E+04	. 113648E+04	.184001E+01
	A. 5			8	A28	B.C.4
	· 4 75504+03	* 115201E+02	. 461476E+01	. 468251E+01	•	•
MAIN SHOCK CUTSING C-D NO 22 LE	3-2 NO 22 EE	FUE 9540.79		FN= 5226.20		SFC= .72925

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	0, 70		.4682516+01	. 461476E:01	.1162015+32	. 64 75 3 0E+ 01	
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er arm	PS28	es.	AHS	PS9	VE	AN CA	
and a second	.48437%E+00		9.	. 441486E-02	¥	. 80 91.792+03	
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W.	.101980E+r1	• 141454E+ 04	. 868027E+02	.5005755-01	, 247995E+01	. 127624E+03	
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